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THE AGRICULTURAL LEDGER.

1899—No. 1.

CYANOTIS AXILLARIS.

(SPIDER-WORT.)

[*Dictionary of Economic Products, Vol. II.*, C. 2522-4.]

VICHKA SEED AS A FAMINE FOOD IN THE BOMBAY PRESIDENCY.

Report on the Results of Examination of the Grain in the Research Department, Imperial Institute. By PROFESSOR A. H. CHURCH, M.A., F.R.S.

Origin of the inquiry.

Early this year, the Survey Commissioner and Director, Land Records and Agriculture, Bombay, kindly forwarded to the Reporter on Economic Products a sample of wild grain called in the vernacular *Vichka*, which had been identified by the Officer-in-charge, Botanical Survey, Bombay, as **Cyanotis axillaris**, *Ræm. & Schultes.*

From information furnished along with the specimen, it is learned that, in January 1898, a considerable number of the people of Malsiras and Pandharpur in the Bombay Presidency were subsisting on this and three other wild food grains. A description of the latter will be found in *Agricultural Ledger* No. 19 of 1898.

Mode of preparing for food.

To prepare the *Vichka* for food the grain of **Cyanotis axillaris** is stated to be ground and cooked with a large quantity of water; when sufficiently boiled it is allowed to get cold, then a little salt and jaggery are added to make it palatable. Thus dressed it is said that the grain satisfies hunger, but is not nourishing.

Conf. last para. on page 3.

Attention was drawn to this wild food substance by Dr. W. Gray in a paper read before the Medical and Physical Society of Bombay

CYANOTIS axillaris.

Vichka Seed as a Famine Food

IMPERIAL INSTITUTE.

in 1882, and he there gave an analysis of the grain made by Professor Lyon, Chemical Examiner.

It was, notwithstanding the above facts, thought desirable, on receipt of the present sample, to send a portion to the Research Department of the Imperial Institute, where Professor A. H. Church, F.R.S., is presently conducting an examination of Indian Food Stuffs on a special plan of his own in which for comparative purposes he brings out very prominently the nutrient-ratio.

Professor Church's Report, by the courtesy of Sir F. A. Abel, Bart., K.C.B., has now been received. It will be observed to be even more encouraging than the previous analysis seemed to indicate.

The figures worked out by Professor Lyon are given here for purposes of comparison. These have been taken from Dr. Dymock's *Vegetable Materia Medica of Western India*, page 891.

	Average cereal.	Average pulse.	Cyanotis axillaris.
Water	11·62	10·00	10·26
Fat	3·00	3·50	0·62
Albuminates	9·12	25·06	15·99
Carbo-hydrates	71·26	51·30	54·79
Cellulose	3·00	7·14	9·36
Ash	2·00	3·00	8·98
Containing nitrogen (per cent.)	1·46	4·01	2·58
Nitrogen (grains per oz.)	6·38	17·86	11·28
Nutritive carbon (grains per oz.)	170·00	170·00	145·80
Percentage of nutritive value as compared with—			
Average cereal	100·00	...	85·76
Average pulse	...	100·0	...

in the Bombay Presidency. (*A. H. Church.*) CYANOTIS axillaris.

PROFESSOR CHURCH'S REPORT.

Report on the Results of Examination of **Cyanotis axillaris,** *by* PROFESSOR A. H. CHURCH, M.A., F.R.S.

This annual, which belongs to the N. O. COMMELINACEÆ, is common in many parts of India. Though anything but promising in appearance it has been used as food in times of famine. The seeds are spongy and light; 100 weigh only 4 grains. The sample received was largely charged with earthy matter which it was impracticable to remove entirely.

Chemical composition.

These percentages were obtained :—

Water	11·5
Albuminoids (from total nitrogen)	13·9
Starch, etc. (by difference)	64·1
Oil	0·5
Fibre	3·1
Ash (includes some sand)	6·9

The nutrient-ratio is here 1 : 4·6, the nutrient-value 79. By the phenol method 12·22 per cent. of albuminoids was shewn.

After all these poor-looking seeds possess a good nutrient-ratio and a fair alimentary value.

C. 2522-4.

G. I. C. P. O.—No. 472 R. & A.—20-4-99.—2,225—W. G.

(Vegetable Product Series, No. 47.)
(Fibres.)

THE

AGRICULTURAL LEDGER.

1899—No. 2.

CALOTROPIS GIGANTEA.

(SWALLOW-WORT.)

[*Dictionary of Economic Products, Vol. II.*, C. 170-90.]

MADÁR BAST FIBRE.

Report by PROFESSOR WYNDHAM R. DUNSTAN, F.R.S., *Director of the Scientific and Technical Department, Imperial Institute, London, on a sample of the bark-fibre obtained from Madras.*

Origin of the Inquiry.

Professor Wyndham R. Dunstan's report, now obligingly furnished by Sir F. A. Abel, Bart., K.C.B., may be suitably prefaced by the following particulars of the circumstances under which the specimen forming the subject of the enquiry was collected.

In 1894 the authorities at the Imperial Institute applied to the Government of India for a quantity of the fibre of **Calotropis gigantea** with a view to investigating its quality.

The indent was forwarded, for necessary action, to the Reporter on Economic Products. In his reply to Sir F. A. Abel, the Reporter pointed out that **Calotropis** yielded two fibres, but that it was assumed the Committee of Scientific and Practical Research desired to examine the bark-fibre, not the floss from the seeds.

CALOTROPIS gigantea. **Madár Bast Fibre.**

MADRAS.

The Directors of Land Records and Agriculture in the several Provinces where the plant occurs, were then invited to co-operate with the Reporter in obtaining the sample required by the Imperial Institute. The following statement shows the Provinces addressed and nature of replies received :—

Madras.	Assam.	North-West Provinces.	Panjab.	Central Provinces.
Offered to supply 20lb of the bark-fibre at a cost of about ₹30.	Process of extracting the fibre unknown : some time necessary before a considerable quantity could be collected.	Not found in the Saharunpur District.	Promised enquiry.	Forest Department replied that only one pound could be obtained.

Advantage was accordingly taken of the assistance kindly offered by the Board of Revenue, Madras, through whom 16lb 6oz. of the fibre (Registration No. 10280) was in due course furnished by the Collector of Chingleput.

The supply was disposed of as follows :—One-half to the Imperial Institute ; one-fourth to the Royal Gardens, Kew ; one-fourth retained for the Indian Museum.

The letter advising despatch of the Imperial Institute sample helps to explain the position of this fibre as an article of commerce.

The information herewith published is well-timed since several inquiries with reference to Madár fibre have been addressed to this office, and various contradictory opinions on its value have been expressed in the Indian newspapers,

From George Watt, Esq., M.B., C.M., C.I.E., *Reporter on Economic Products to the Government of India, to* Sir F. A. Abel, Bart., K.C.B., *Honorary Secretary and General Director, Imperial Institute, London,—No. 243-81 F. S., dated Indian Museum, Calcutta, the 7th February 1898.*

In continuation of this office No. 2519—81 F. S., dated the 13th November 1897, I have now the honour to advise you that a sample

Madár Bast Fibre. (*W. R. Dunstan.*) CALOTROPIS gigantea.

PROF. DUNSTAN'S REPORT.

of the bark-fibre of **Calotropis gigantea** (weighing 8lb) has been forwarded to Mr. Royle, from which a portion will be supplied to the Research Department. You may recollect that you asked for this fibre by your Flying Seal Series No. 28 of the 17th July 1894. The subsequent correspondence explained the delay as due to the difficulty to procure the fibre. While well known to afford a valuable bark-fibre, **Calotropis gigantea** is almost exclusively valued for its silk floss. Indeed the greatest difficulty has been experienced to induce any one to supply the quantity of bark-fibre required, and even now we have only been able to secure a very small sample. You will understand from these circumstances that it is hardly likely to assume importance, but to complete the investigations that your Research Department has already far advanced and is still engaged upon, I shall feel obliged if you can furnish me with a report on the sample now supplied.

Report by Professor Wyndham R. Dunstan, F.R.S., ***Director of the Scientific Department, Imperial Institute, on the*** Calotropis gigantea ***(Madar) from Madras.***

The "Madár" fibre shown in the Indian and Colonial Exhibition of 1886 having attracted some attention, the Sub-Committee on Fibres, acting in connection with the Scientific and Technical Department of the Imperial Institute, asked for a supply of this fibre so that its chemical composition and general characters might be ascertained. In reply to this request, the Department was informed by the Reporter on Economic Products to the Government of India that a small specimen of the bark-fibre had been obtained, in February 1898, after very great difficulty, and it was then stated that owing to the difficulty of obtaining any quantity of the fibre, the subject was unlikely to assume any practical importance. The only chemical examination of this fibre on record is that by Messrs. Cross and Bevan, in their report on the fibres exhibited in 1886, the results of which are given below. The sample now examined differs in some respects from that dealt with by Messrs. Cross and Bevan in particular, the length of the staple is greater, averaging 12 inches. Chemical examination by the method followed in the Scientific Department of the Imperial Institute in investigating the composition

Difficulty of obtaining Fibre.

CALOTROPIS gigantea. **Madár Bast Fibre.**

PROF. DUNSTAN'S REPORT.

and characters of fibres, furnished the following results, which may be compared with those of Messrs. Cross and Bevan:—

Chemical Composition.

	Cross and Bevan.	Imperial Institute.
Moisture, per cent.	7·3	8·88
Ash, per cent.	2·5	3·25
Hydrolysis (*a*), loss per cent.	13·0	10·86
Hydrolysis (*b*), loss per cent.	17·6	13·82
Mercerising, loss per cent.	...	11·82
Acid purification, loss per cent.	8·5	8·58
Nitration, gain per cent.	53·5	56·96
Cellulose, per cent.	76·5	84·25
Length of ultimate fibre	10—30mm.	10—30mm.

A comparison of these figures shows that, on the whole, the latter sample is the better of the two. These results will be useful as a record of the composition of this fibre, although at present the subject may not possess any commercial interest.

NOTE.—It may be convenient to explain here the terms used in the foregoing and all other technical analyses of fibres.

Hydrolysis. (*a*) refers to the loss in the fibre when it is boiled for five minutes in a diluted solution caustic soda (1 per cent. Na_2O); and hydrolysis (*b*) represents the loss sustained when the boiling is continued for one hour.

Mercerising. denotes the solvent action occasioned by immersing the fibre for one hour in a concentrated solution of the caustic alkali (33 per cent. Na_2O).

Acid purification. When the fibre is heated to the boiling point with acetic acid to remove accidental impurities, the loss is thus recorded.

Nitration. The gain in weight the fibre undergoes when immersed in a mixture of equal parts of strong nitric and sulphuric acids.

Cellulose is the purified fibre after it has been submitted to the successive treatment of dilute alkali, chlorine, sodium sulphite and acetic acid.

C. 170-90.

G. I. C. P. O.—No. 136 R. & A.—1-8-99.—2,225.

(Vegetable Product Series, No. 48.)

(Fibres.)

THE AGRICULTURAL LEDGER.

1899—No. 3.

VILLEBRUNEA INTEGRIFOLIA.

(BAN RÍHA.)

[*Dictionary of Economic Products, Vol. VI., Pt. IV.*, V. 133.]

BON OR BAN RÍHA: WILD RHEA.

Report by PROFESSOR WYNDHAM R. DUNSTAN, F.R.S., *Director of the Scientific Department, Imperial Institute, on samples of the bark-fibre from Assam: Also an introductory review by* THE EDITOR.

INTRODUCTORY.

For a recent account of **Villebrunea integrifolia**—the Ban Ríha (or Rhea) of Assam—reference should be made to *The Agricultural Ledger* No. 15 of 1898 (pp. 108—119), in which is given a revision of the Dictionary account of that plant.

Professor Wyndham R. Dunstan's Report, here reproduced by the courtesy of Sir F. A. Abel, may be regarded as a continuation of that account and as confirming—so far as is possible at present—the exceedingly favourable views already expressed of **Villebrunea** as a commercial fibre. Its superiority over ordinary Rhea in regard to strength, texture and composition, cannot but be considered as a most important result and one which should commend it to the favourable attention of all persons interested in Rhea fibre. As a catch crop to the Tea Industry it has perhaps no rival, certainly no equal. The

INTRODUCTION.

fact that this fibre may be cleaned by simply retting the ribbons of bark (after the fashion of Jute) is perhaps of even more interest than its exceptionally high merit as a textile. Expensive decorticating and degumming machinery and methods are thereby rendered unnecessary. It is thus possible that the fibre could be turned out at a price that would not only undersell Rhea, but, for certain purposes, compete with Flax, if not with Jute itself. At all events the cultivation and separation of a crudely cleaned fibre of great merit might easily enough be accomplished by even the poorest agriculturist. While Rhea must of necessity command capital and enterprise, Ban Rhea can be developed by the peasant.

As an introduction to Professor Dunstan's valuable and interesting Report the following correspondence may be given on the subject of *Ban Ríha* fibre which explains the circumstances under which the sample was forwarded to the Imperial Institute for examination and report.

From George Watt, Esq., M.B., C.M., C.I.E., *Reporter on Economic Products to the Government of India, to* Sir F. A. Abel, Bart., K.C.B., *Honorary Secretary and Director, Imperial Institute, London,—No. 994-75 F.S., dated Indian Museum, Calcutta, the 28th April 1898.*

I am sending to the address of Mr. Royle, our Curator at the Imperial Institute, a consignment of Ban Ríha fibre. This article has been spasmodically discussed for the past 50 years, but only in a superficial way. Various writers have extolled the merits of the fibre, but no practical tests have been performed and no progress made. Moreover, as the word Ban Ríha means wild Rhea, various writers have spoken of Rhea and China-grass as indigenous to India, and have created false hopes as to our limitless resources in that fibre. During my explorations in Assam I gave special consideration to the Ban Ríha. I found, as I had suggested in the *Dictionary of Economic Products*, that while related no doubt to **Bœhmeria nivea** it was a perfectly distinct plant, namely, **Villebrunea integrifolia.** The explanation of the name Ban Ríha, as it seems to me, may be the reverse to that generally supposed. This is a truly wild plant and to this day is nowhere cultivated, though its fibre is highly appreciated and regularly utilised by the hill tribes of Assam. On the Chinese grass cloth being introduced it was somehow or other recognised as related to the indigenous plant, and accordingly received

Bon or Ban Ríha: Wild Rhea. (*G. Watt.*) VILLEBRUNEA integrifolia.

CORRESPONDENCE with IMPERIAL INSTITUTE.

the old name of Ríha, the wild plant being spoken of as the wild Ríha. Certainly **Bœhmeria nivea** and its variety **B. tenacissima** are not indigenous to India, and are nowhere even sufficiently naturalised to exist as escapes from cultivation. Ríha means, in Assamese, the cloth that covers the heart or breast. I have reason to believe shawls made of the Ban Ríha may have originally been so designated. The word is Ríha, not Rhea, and is pronounced Ree-ha.

2. But to turn from these general statements and opinions to the important aspects of the subject. **Villebrunea** can be grown on all waste lands; it has little or no gum,* will give a high return where Ríha fails; it is a very fine fibre, and perhaps as strong, if not stronger, than China-grass. On these considerations I am to make an effort to bring this fibre to the attention of Commerce, and I shall be very grateful if you can see your way to secure the co-operation of the Officers of the Research Department. Mr. Royle will hand over to you three-fourths of the present consignment. I desire to have the fibre examined both chemically and industrially. For the latter purpose I shall be pleased to send a larger consignment on my hearing from you. All that has been done is to strip the ribbons off the stems. These have not been cleaned in any way, and the loss no doubt will be found serious. The plant produces shoots 20 feet long; the bark strips off easily, but no doubt machinery could be readily designed to produce a cleaned and partly bleached raw fibre. The most important point in connection with this fibre is that it could be produced at a third the price of Ríha. I trust, with all these facts before you, that you may see your way to co-operate with me in the effort to give to India a perfectly new commercial fibre.

* *Confirmed, page 4.*

To the above Sir F. A. Abel replied:—

In acknowledging the receipt of your letter of the 28th April (994—75 F. S.), on the subject of Ban Ríha fibre, of which you are sending a consignment, to the Curator of the Indian Section of the Institute, I have to state that no time will be lost, after receipt of the sample which you have instructed Mr. Royle to hand to me,—in submitting the fibre to the usual comparative chemical examination, and in obtaining opinions as to its probable value from Experts. In applying to the latter, I shall inform them that a larger consignment is in course of transmission, in order that the fibre may be thoroughly tested practically.

VILLEBRUNEA integrifolia. — Bon or Ban Ríha: Wild Rhea.

PROFESSOR DUNSTAN'S REPORT.

On the 9th June 1898 advice was given of the despatch to London of a further supply of the fibre, *viz.*, two parcels of 50 lbs. and 70 lbs. respectively (Register Nos. 10472 and 10605).

On the 20th October Sir F. A. Abel replied as follows:—

"With reference to your letters No. 243—81 F. S., dated 7th February 1898, and No. 994—75 F. S., dated 28th April 1898, I have the honour to forward, herewith, a Report by Professor Dunstan, Director of the Scientific and Technical Department of the Imperial Institute, on the fibre of **Villebrunea integrifolia**, Ban Rhea.

"The last paragraph of the Report refers to a special process, specified to me as being a very simple one, by which these fibres can readily be treated. A specimen of the Ban Rhea bark-fibre has been treated by this process; and the fibre yielded by it is of high quality in regard to strength and texture.

"Should it not be practicable to ensure that a properly retted and prepared sample of the Ban Rhea fibre, obtained by precisely *the same* treatment as adopted in the case of the Rhea fibre received for examination, can be sent home, it would be better to have samples of Rhea and Ban Rhea fibres specially prepared here by the same process for comparative examination."

Report by Professor Wyndham R. Dunstan, F.R.S., ***Director of the Scientific Department, Imperial Institute, on*** Villebrunea integrifolia ***(Ban Rhea) from Assam.***

"An examination of 'Ban Rhea' fibre was particularly asked for by Dr. Watt (letter dated 28th April 1898). Unfortunately the untreated bark-fibre was sent for examination, consisting of the bark peeled from the plant—containing the bark-fibres in strips from 3 to 5 feet in length. The only course to adopt was to imitate as nearly as possible the retting process adopted on an industrial scale, which the almost complete absence of gum rendered possible. Two samples of fibre were received. A small quantity of each was placed in dishes, covered with water and allowed to stand for about three weeks, after which time one of the samples was sufficiently soft for the fibre to be removed. This was carefully combed and picked, and by this means about 10 grams of a nearly clean brown fibre in long silky threads were procured. The fibre thus

Reg. Nos. 10472. 10605.

PROFESSOR DUNSTAN'S REPORT.

treated was then submitted to the usual examination with the following results :—

	Ban Rhea	Bœhmeria nivea.
Moisture, per cent.	10·93	9·0
Ash, per cent.	3·52	2·9
Hydrolysis (*a*), loss per cent.	8·22	13·0
Hydrolysis (*b*), loss per cent.	15·82	24·0
Mercerising, loss per cent.	8·05	11·0
Acid, purification, loss per cent.	5·09	6·5
Nitration, gain per cent.	56·88	25·0
Cellulose, per cent.	80·04	80·3
Length of ultimate fibre	40mm. and upwards.	40—200mm.

Ban Riha and Bœhmeria nivea compared.

"It is interesting to compare these numbers with those obtained in the examination of the fibre of **Bœhmeria nivea** (commonly known as 'Rhea' or 'China-grass') made by **Messrs. Cross and Bevan. Dr. Watt** has pointed out that these two fibres are certainly distinct; the Ban Rhea may be the more important of the two owing to its growing wild on waste land, to its containing little or no gum, and also because it furnishes a silky fibre at least as strong as China-grass, with which, indeed, it, and not **Bœhmeria nivea,** may prove to be identical. A comparison of the results of the examination of these two fibres clearly brings out the superiority of the Ban Rhea, especially in regard to its smaller loss by hydrolysis and its higher nitration number. At the same time it must be remembered that the process adopted in treating this fibre in the Laboratory only very roughly approximates to that which would be used on a large scale.

Excellence of Ban Riha.

"Portions of the original samples have been submitted to a fibre expert, who reports that they can be readily treated by a special and simple process which has recently been devised. Further information as to this process can be supplied if this aspect of the matter is thought to be of importance.

"In any case a sample of the properly retted and prepared fibre should be sent for chemical examination."

G. I. C. P. O.—No. 524 R. & A.—1-5-99.—2,225.—J. E. F.

Vegetable Product Series, No. 49.)
(Food Substances.)

THE AGRICULTURAL LEDGER.

1899—No. 4.

ELEUSINE CORACANA.

(RAGI.)

(*Dictionary of Economic Products, Vol. III.*, E. 170-83.]

RAGI TAILINGS AS A PRISON FOOD IN THE MADRAS PRESIDENCY.

Report on the results obtained by PROFESSOR A. H. CHURCH, M.A., F.R.S., *in the examination of three samples forwarded to the Imperial Institute for analysis.*

Introductory.

The subject of the nutrient value of the "Tailings" or seed-coat of the Millet **Eleusine Coracana** has recently been drawn attention to by the Inspector General of Prisons, Madras. Readers of Professor Church's very useful Hand-book "Food-Grains of India," will find the results here given of his further inquiries into the subject of "Ragi" of more than ordinary interest.

From what follows it will be seen that the special question raised by the Inspector General of Prisons, Madras, as to the value of the outer coat of the grain or "Tailings," has been very carefully considered by Professor Church. His guarded statements will no doubt, for the present at least, go to reconcile any difference of opinion which may have hitherto existed regarding the value or otherwise of the outer skin as an article of diet. The letter below, which was received by the Reporter on Economic Products from the Inspector General, gives in a convenient form the history of this enquiry, and

HISTORY of the INQUIRY.

is accordingly reproduced in full (*letter No. 1042, dated 28th March 1898*) :—

"In the Jails of the Madras Presidency the prisoners are mainly fed on *Ragi* (Eleusine Coracana, *Gaertn.*), ground into flour and boiled into a pudding about the consistency of *blanc-mange*. A question which is constantly arising is as to the amount of nutrition which is furnished by the outer skin or rind of the grain, not the husk or floral envelop which is, of course, rejected, but the red or black skin which forms the outermost layer of the grain itself. It is generally accepted that this skin or rind is difficult of digestion, and that it requires to be ground as fine as possible, but while some Jail Officers believe that this outer rind contains salts which are of special value as part of the food, others contend that the rind is almost entirely innutritious, except for the particles of starch which must adhere to it even after the most thorough grinding.

"2. I have the honour to enquire whether you can refer me to any writings possessing undoubted authority which bear on or decide this question. If there are no analyses made by analysts of repute, on the constituents of the outer coat of *ragi*, the analogy of other grains might be of value, and I would enquire whether, according to prevailing scientific opinion, the outer coat of wheat (that which gives its colour to brown and black bread) is held to be at all nutritious, and if at all, to what extent as compared with the flour composing the heart of the grain.

"3. Lastly, I beg to ask whether, if no authoritative analyses of *ragi* have been made, you could arrange for their being carried out either in India or in Europe or both. The question is one of great practical importance. In this Presidency, with a daily average population of from 9,000 to 10,000 prisoners, each receiving 1½lb of *ragi per diem*, the value of the rind or "tailings" of *ragi* amounts to a large sum annually. If this rind is absolutely innutritious, it should not be issued to convicts, for it undoubtedly shows little apparent yielding to the processes of cooking and passes from the bowels but little modified in appearance. If, on the other hand, it does contain nutriment it ought not to be rejected, for its rejection would involve a considerable annual outlay."

The Inspector General of Prisons having been asked by the Reporter to furnish about 2oz of the grain as used in the Madras

MEMORANDUM by PROFESSOR CHURCH.

Jails, the sample was in due course received and despatched to Sir F. A. Abel, Bart., K.C.B., Honorary Secretary and Director, Imperial Institute, with the request that he would invite Professor Church to examine the outer coat of the grain.

Sir F. A. Abel kindly responded as follows :—

"I have to inform you that I communicated with Professor Church in reference to the suggestion that he should analyse the outer coat or skin of *ragi*, with a view to determine its composition and nutritive value, and to decide whether it would be likely to prove a suitable article of diet for prisoners. Professor Church informs me that he has analysed several Indian samples of *ragi*, both husked and unhusked, but that as the husk itself has not been examined apart, he is prepared to examine it with special reference to the above questions provided he receives about four ounces of the material.

"With regard to the question raised by the Inspector General of Prisons, Madras, Professor Church has furnished me with a memorandum, of which I enclose a copy."

Memorandum by Professor A. H. Church, F.R.S., *on the enquiry made in para. 2 of the letter from the Inspector General of Prisons, Madras.*

Wheat: Pollard and Bran.

"1. The coarser products obtained in milling wheat vary greatly in nutritious properties according to the mechanical process adopted for their production and separation. Those commonly known here as pollard and bran contain about 10 per cent. of indigestible fibre, but this is associated with more fat, more nitrogenous matter and more phosphates than are present in the various grades of flour. On the other hand, these valuable nutrients are in a great measure inaccessible to the digestive juices. This is the case for two reasons; *firstly*, because these coarser mill-products are hurried through the digestive tract owing to their irritating character; *secondly*, because they contain a large proportion of their nutritious constituents locked up in the woody fibre.

"2. The defects of pollard and bran, pointed out above, may be partially obviated by re-grinding these products, so as to reduce them to the fineness of middlings and sharps. Some particulars as to these mill-products from wheat will be found discussed in Professor Church's South Kensington Museum Manual on *Food*, pages 65 to

PROFESSOR CHURCH'S REPORT.

79 (last edition), and much more briefly in his "Food-Grains of India," pages 95, 96.

"3. Without an examination of a typical sample of the coarser mill-products from Indian wheat which it is proposed to use in prison dietaries, it would be impossible to compare its available nutriment with that in true flour. Chemical analysis, without actual trial of digestibility, does not furnish a complete answer. Professor Church knows of one case where wheat "offal," after being re-ground, gave the ratio of 77 to 100 when compared with wheat flour. Here the quantity of undigested nutritive materials in the ejecta was determined.

Professor Church's special report which follows was subsequently furnished through the courtesy of Sir F. A. Abel :—

Report on the results of examination of three samples of Ragi Tailings, by Professor A. H. Church, M.A., F.R.S.

Chemical Composition.

The following table presents the percentages obtained in the analysis of the three samples of Ragi Tailings forwarded to me by the Imperial Institute in connection with the letter No. 3845, dated 18th July 1898, from the Inspector General of Prisons, Madras :—

	I.	II.	III.
Water	11·6	11·6	11·2
Albuminoids (from total nitrogen)	8·2	9·5	8·2
Starch, etc. (by difference) .	71·2	68·7	71·8
Oil	1·1	2·0	1·7
Fibre	4·2	4·7	3·8
Ash	3·7	3·5	3·3
Albuminoids by Phenol method	8·1	8·3	8·1
Nutrient-value . . .	81	81	83
Nutrient-ratio . . .	1 : 9	1 : 7·6	1 : 9·2

Sample I.—Ragi that has been ground once and sifted once through a coarse wire-gauze sieve.

Sample II.—Ragi that has been ground twice and sifted first through a coarse wire-gauze sieve, and secondly, through a fine wire-gauze sieve.

Sample III.—Ragi that has been ground twice and sifted twice through a fine wire-gauze sieve.

The three samples are obviously very much alike, though No. II. is richer in albuminoids (*i.e.*, 'flesh-formers') than the others, and consequently shows a more favourable 'nutrient-ratio,' that is, a better

PROFESSOR CHURCH'S REPORT.

proportion of flesh-forming to heat and energy-giving constituents. Even in the case of No. II. a small addition of pulse is desirable.

In my "Food-Grains of India" will be found analyses of whole and husked grain of *ragi* **(Eleusine Coracana).** There is also an analysis by **Dr. McNally** in the "Government of Madras Paper No. 445, 1886." These older results do not diverge very widely from those now obtained with Ragi Tailings. I confess, however, that the figures which I now report, so far as the proportions of indigestible fibre are concerned, are unexpected. I thought it likely, from the appearance of the samples, that they would show a much higher percentage of this non-nutritious constituent than 4 or 5. But it must be borne in mind that the chemical method of treatment (with acid and alkali) used in determining fibre is a very drastic one, by no means equivalent to the action of the digestive juices, but greatly exceeding it. Two other considerations must also be kept in view. The fibre of these grains undoubtedly serves to lock up, and so to render unavailable a part of the albuminoids, a part of the oil or fat, and a part of the mineral matter present in these tailings. Again, the coarseness and roughness of the seed-coat of this millet cause this food-stuff to be hurried through the intestinal tract at such a rate that much of the nutrient matter, which might otherwise be absorbed, escapes digestion and assimilation, and is lost in the fæces. For these reasons the chemical figures I have given convey a physiological impression of nutritive value greater than that which such a food-stuff as this really possesses in alimentation. An experiment in artificial gastric and pancreatic digestion, which I have tried with sample No. III, demonstrates this conclusion; but one cannot, in the laboratory and without actual feeding trials, complete the necessary correction, by ascertaining what proportions of the several nutrients will in practice escape digestion, in consequence of the too-brief sojourn of the food-stuff in the intestines. I regret that I do not possess data enabling me to make a definite statement on this point. I should like to have been in a position to define the precise quantities of albuminoids, of starch and other carbo-hydrates, and of oil, which, in one pound of Ragi Tailings, must be regarded as useless in nutrition.

In conclusion, I would refer the Inspector General of Prisons, Madras, to the observations and tables relating to Dietaries and Rations to be found on pages 16 to 30 of my "Food-Grains of India."

E. 170-83.

G. I. C. P. O.—No. 691 R. & A.—27-5-99.—2,225.—H. R.

(Medical and Chemical Series, No. 13)

(Narcotics.)

THE AGRICULTURAL LEDGER.

1899—No. 5.

HYOSCYAMUS MUTICUS.

(INDIAN HENBANE.)

[*Dictionary of Economic Products, Vol. IV.*, H. 524*a*.]

INDIAN HENBANE AS AN INTOXICANT IN SIND.

Including a Report on its analysis by PROFESSOR WYNDHAM R. DUNSTAN, M.A., F.R.S., *Director of the Scientific Department, Imperial Institute, London.*

Sources of Indian Henbane.

In the "Flora of British India" three species of **Hyoscyamus** are recorded: **H. niger**, *Linn.*, found in the Temperate Western Himalaya; **H. pusillus**, *Linn.*, of Western Tibet; and **H. muticus**, *Linn.*, a plant of Western Panjab and Sind, distributed to Kabul and westward to Egypt. To these species might be added **H. reticulatus**, *Linn.*, a plant found by **Dr. Aitchison** in Badghis where it is common at altitudes above 2,500 feet.

Early History.

The Henbane of the Himalaya has been called *Banj* by Muhammadan writers, a word which is an Arabic corruption of the Persian *Bang*. **Baron Hammer-Purgstall** makes the following observation regarding the origin of the word: "*Bendj*, the plural of which in Coptic is *nibendj*, is without doubt the same plant as the *nepenthe* which has so much perplexed the commentators of **Homer**. **Helen** evidently brought the *nepenthe* from Egypt, and *Bendj* is there still reputed to possess all the wonderful qualities which **Homer** attributes to it." **Mir Muhammad Husain's** description of *Banj* in the Makhzan agrees with the genus **Hyoscyamus**, of which, he says, there are three kinds—white, black, and red. (*Pharmacographia Indica*).

HYOSCYAMUS muticus. **The use of Indian Henbane**

EARLY HISTORY.

Henbane is referred to by Eastern writers as intoxicating, and probably by some has been confused with Indian hemp (**Cannabis sativa**), especially that form of the drug known as *Bhang*, or according to Polak *Bang*. Achundon (Die Pharmakologischen Grundsätze des Abu Mansur Muwaffak bin Ali Harawi, 1893, page 167) says that *bang* is equivalent to Henbane (**Hyoscyamus**), and that Hemp (**Cannabis**) is called *Sehâhdânadsch*. Although this and other writers discriminate between the two intoxicants, it would appear that the term *bhang* which is now applied to the dried leaves of the **Cannabis**, was in olden times used to designate the prepared leaves of Henbane.

Dr. Stocks' Account.

One of the first European writers on **Hyoscyamus muticus** was **Dr. J. E. Stocks**, Assistant Surgeon, Conservator of Forests and Superintendent of Botanic Gardens, Bombay. **Dr. Stocks** discovered this plant growing from chinks of rock or in soft soil in rocky ground throughout Baluchistan, and under the name of **H. insanus** he described it in his paper "On Beloochistan Plants" in "Hooker's Journal of Botany," Vol. IV. (1852), p. 178. It was there known as *koh-i-bhang*, or mountain hemp. It was said to be smoked in small quantities by debauched *Fakirs* and to be used by evil disposed persons to injure those with whom they had a quarrel. It was described as causing dryness and constriction of the throat, and furious delirium. Its action was known to every native, but **Dr. Stocks** met with no one who had smoked it either by design or accident.

Occurrence in North Africa.

An interesting account of a poisonous **Hyoscyamus** found in North Africa, and presumably the species under consideration, is taken from the *Pharmaceutical Journal*, December 1st, 1883, page 425.

"A species of henbane is described in the *Journal de Pharmacie* ([5] VIII., 415), under the Arabic name of "El Bethina," which is believed to be the plant employed by the Touaregs to get rid of the members of the Flatter's mission. This kind of henbane is met with frequently a few days' journey to the South of El Golea in the Sahara region. It grows in isolated tufts and attains a height of 50 to 60 centimetres, flowering in March and fruiting in June. The plant is used by the Sahara Arabs for criminal purposes; it is known to be poisonous to the camel and horse, but is said to be eaten with impunity by the gazelle and sheep. The natives use the herb in the form of pulp or powder which is mixed with

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dates or milk. The antidote used is pepper and butter, mixed with water that has been triturated with dates. This produces profuse perspiration, and the patient recovers without having experienced hallucination. The leaves of the plant are oblong, lanceolate, and slightly tomentose sinuate, but not toothed, and amplexicaul at the base. The flowers are whitish, funnel-shaped, a little longer than the calyx, which has mucronate, but not reflexed teeth, and is stalked. The bract which subtends the scorpioid cyme is shortly stalked, oblong, linear and entire."

This plant is also referred to in the "Kew Bulletin," July and August 1896, where an interesting note is supplied by Rear-Admiral Blomfield, Port House, Alexandria, written on the 31st December 1895.

Egypt.

"We have lately lost," he writes, "Dr. Sickenberger, a very valued old friend of mine and most kind hearted and modest; he was an excellent botanist. He was a victim to overwork in connection with analyses of poisoning cases which he had undertaken for the tribunal when he ought to have been having a complete rest in Europe.

"In connection with his work, I may mention that this summer I observed a native gathering seeds from a large plant near some houses at Mex, five miles west of this, which I found to be **Hyoscyamus muticus.** The plant was three or four yards in circumference and was in full flower, with its handsome purple blossoms, as well as in fruit. I remembered having seen it in plenty in the valleys near Helonan, south of Cairo, but never before here, and sent a specimen to Dr. Sickenberger, who told me in reply that he had just established four cases of family poisoning (not accident) by the same seeds.

"The natives call the plant 'sakrân,' which means 'drunken' with reference to its properties, a name which at Mex is given to the **Hyoscyamus albus,** which is common there and used medicinally by the natives. How this one plant (the only one known) of **H. muticus** came to existence at Mex no one knows. I will send you a sample."

India.

Reverting to the wild plant grown in India and the steps taken to enquire into its poisonous principle, the following notes will give the history of the case:—

The Commissioner of Sind (the Honourable Mr. H. E. M. James, C.S.I.), in 1894 in a correspondence with Dr. Watt, the Reporter on

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Economic Products, incidentally alluded to an intoxicant used in that district. On being applied to for particulars concerning the drug, **Mr. James** made the following reply :—

Letter from Commissioner of Sind.

"In your note of the 8th August 1894, you asked about the Henbane intoxicant. **Mr. Woodrow** has identified it as **Hyoscyamus muticus**, *Linn.* Beluchis, who use it as an intoxicant, dry the leaves and flowers and smoke the mixture exactly like *ganja*. But it is very powerful and makes them positively mad. Under its influence they strip themselves naked, and dance about like lunatics. It grows wild about the Khirtar Mountains where it flowers in March. I have ascertained that it is used in this way all along the Sind border. Beluchis and Sindhis (and especially those of mixed Seedee and Beluch breed, calling themselves Gaddos or Khaskelis, the descendants of slaves) are addicted to Hemp drugs which are grown or manufactured in Sind on the Muncher Lake, and the use of henbane is stimulated, probably on account of the sale of those drugs being a monopoly and the drugs themselves more expensive, and also on account of the distance of the hills from shops where *ganja* is sold."

Collection of the drug.

The Commissioner very kindly took steps to procure a supply of the henbane for investigation, and in August 1896 a box containing ten pounds of the dried plant was received from the Commissioner's office, Karachi. The plants had been procured from Khairpur by a police constable who had been deputed from Sukkur to collect them for this special purpose. The larger portion of the plant was sent to the Research Department of the Imperial Institute, London. In the ensuing March the Commissioner obligingly forwarded botanical specimens of the henbane, and these proved identical with the plant previously determined.

The following letter was accordingly addressed to **Sir F. A. Abel, Bart., K.C.B.**, on the subject of the despatch to the Imperial Institute on the 18th September 1896, of a sample of this Henbane :—

Despatch to Imperial Institute.

I have the honour to forward a small parcel of **Hyoscyamus muticus** collected in Sind.

This Indian species of **Hyoscyamus** is reported to be very virulent in its action when compared with **H. niger** of Europe, and on account of its poisonous properties it was named **H. insanus** by **Dr. Stocks.**

as an Intoxicant in Sind. (*W. R. Dunstan.*) HYOSCYAMUS muticus.

DESPATCH TO IMPERIAL INSTITUTE.

As the plant has never, to my knowledge, been chemically analysed, I think an examination of its alkaloids would form the subject of an interesting investigation in the Research Department of the Imperial Institute.

I am this week forwarding about 8½ lbs. of the dried plant (to the Agent, Government Consignments, for despatch) to London.

Sir F. A. Abel expressed his interest in the proposed investigation and handed the specimens to the Director of the Scientific Department Professor Wyndham R. Dunstan for examination.

Towards the close of last year the report was concluded, and the results were communicated to this department in the appended correspondence.

Flying seal series No. 161, dated the 1st December 1898.

From—Sir F. A. Abel, K.C.B., *Honorary Secretary and Director, Imperial Institute, London,*

To—*The Reporter on Economic Products to the Government of India, Indian Museum, Calcutta.*

Letter from Sir F. A. Abel.

With reference to your letter No. 2820—136, Flying Seal Series, dated 15th September 1896, suggesting that a sample of the plant **Hyoscyamus muticus,** the despatch of which was advised therein, should be examined in the Scientific Department of the Imperial Institute, I have the honour to forward herewith a report by Professor Wyndham R. Dunstan, Director of the Scientific Department, on the subject.

Report by Professor Wyndham R. Dunstan, F.R.S., ***Director of the Scientific Department, Imperial Institute, on the*** Hyoscyamus muticus ***of India.***

Report by Professor Dunstan.

A chemical examination has been made of the constituents of **Hyoscyamus muticus,** sent by the Reporter on Economic Products (Flying Seal Series, No. 2820—136, dated 15th September 1896). It has been ascertained that this plant contains the valuable alkaloid, hyoscyamine, to the extent of about 1 per cent., and that this alkaloid can be readily extracted from the plant in a practically pure state. A detailed account of this investigation is about to be communicated to the Chemical Society of London, and it is probable that some demand may spring up for the plant in this country, where at present drugs of this class are scarce, whilst there is, at the same

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Examination of the Alkaloid.

"In order to identify the alkaloid or alkaloids present, the impure amorphous residues were converted into the aurichloride, which was examined by fractional crystallisation, as described in a previous paper on the alkaloids of **Scopola carniolica** (*Dunstan and Chaston*, *Ph. J.* [III], 20, 461); this was obtained as a yellow pulverulent precipitate, which was recrystallised from hot water acidified with hydrochloric acid. The alkaloid from the mixed stem and leaf yielded two large fractions of auric chloride melting at 154—156°, and after recrystallising, at 157—158°, which is very near the melting point of hyoscyamine aurichloride. From the mother liquors, containing the excess of auric chloride, two very small fractions of crystals were obtained melting at 149—150° and 140—145°, respectively; these were too small to be dealt with separately.

Alkaloid from stem and leaf.

Alkaloid from the stem.

"The alkaloid from the stem yielded three main fractions of aurichloride all melting between 154° and 156°. On recrystallising once, three fractions melting at 158°, 157·5° and 154—156° were obtained; by concentrating the mother liquors from these, two small fractions melting at 150—155° and 145—150° were obtained, and, finally, a few crystals melting at 141—145°. The fractions of similar melting points were combined and recrystallised from dilute acid until a constant melting point was attained. In the case of the fractions of higher melting point, two or three recrystallisations sufficed, whereas the lower fractions required the operation to be repeated at least six times before a constant melting point was obtained; by this means, practically the whole of the aurichloride originally taken was obtained in shining leaflets melting at 159·5°. There only remained two small fractions melting at 157—158° and the two lowest fractions at 140—145°, which were too small to be separately dealt with, and were consequently retained and afterwards combined with a fraction of similar melting point.

Hyoscyamine identified.

"It is, therefore, proved that nearly the whole of the aurichloride is that of hyoscyamine, which melts at 160° (*Ladenburg*).

"The small quantity of alkaloid which remained in the alkaline liquid and was not removed by agitation with chloroform was isolated in the following manner (*Dunstan and Ransom*, *Ph. J.* [III], 14, 623). The chloroform and alcohol present were removed by

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distillation under reduced pressure, the liquor was acidified, and the whole of the alkaloid precipitated by adding a solution of iodine in potassium iodide; the alkaloidal periodide was collected, washed, and then decomposed by a small quantity of a solution of sodium thiosulphate, the liquid made alkaline with dilute ammonia, and the alkaloid extracted with chloroform. The small quantity of alkaloid thus obtained was converted into the aurichloride, but this could not be recrystallised and was mixed with the lowest melting fractions (above referred to) for further treatment.

Analysis of the Aurichloride.

Aurichloride of alkaloid analysed.

"The pure aurichloride melting at 159·5° was analysed, the gold, chlorine, and alkaloid, being directly determined. A weighed quantity of the salt was dissolved in water, the gold precipitated as sulphide, ignited, and weighed as metal. After the hydrogen sulphide had been removed from the filtrate by passing a current of air, it was exactly neutralised with soda, and the chlorine determined by titration with centinormal silver nitrate. The filtrate from the silver chloride was concentrated in a vacuum over sulphuric acid, then made alkaline with dilute ammonia, and the alkaloid removed by agitation with chloroform, and the residue obtained on distilling off the chloroform was dried in a vacuum over sulphuric acid until its weight was constant.

I. 0·0636 aurichloride gave 0·0201 Au, and required 42·2 c. c. N/100 Ag NO_3 (1 c. c. = 0. 0003416 Cl). Au=31·60; Cl=22·66.

II. 0·0424 aurichloride gave 0·0134 Au, and required 27·8 c. c. N/100 Ag NO_3. Au = 31·60; Cl = 22·40.

"The two solutions containing the alkaloid from both the above determinations were mixed, and the total amount of alkaloid estimated.

0·106 aurichloride gave 0·0491 alkaloid=46·32 per cent.

	Gold.	Chlorine.	Alkaloid.
Found . . .	31·60, 31·60	22·66, 22·40	46·32
Calculated for $C_{17}H_{23}NO_3$, $HAuCl_4$.	31·34	22·54	45·95

Another specimen of aurichloride yielded, on ignition, 31·25 per cent. of gold.

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"From more of the pure aurichloride, the alkaloid was regenerated by the method above described, and after recrystallisation from a mixture of dry chloroform and petroleum, it was obtained in long, silky needles. These were dissolved in absolute alcohol, and the specific rotatory power determined. The solution was lævorotatory.

$$a = 31'.\ l = 1\ dm.\ c = 2{\cdot}04.\ t = 19^{\circ}$$

$$\text{Whence } [a]_D = \frac{100 \times 31}{2{\cdot}04 \times 60} = -25{\cdot}32^{\circ}$$

Other observers have recorded numbers lying between 20° and 21°.

Hyoscyamus muticus *as a Commercial Source of Pure Hyoscyamine.*

A commercial source of pure alkaloid.

"Having thus ascertained that the alkaloid in **Hyoscyamus muticus** is chiefly, if not entirely, hyoscyamine, experiments were made to extract the crystalline alkaloid direct from the plant. For this purpose about 1½ lbs. of the plant, both stem and leaf, was finely powdered and the alkaloid extracted by the method already described; in this way 0·7 gram of impure alkaloid was obtained as a coloured, gummy residue, which could not be crystallised either from ether or from dilute alcohol. By dissolving in dry chloroform, however, and gradually adding light petroleum, the colouring matter was precipitated, together with a little of the alkaloid, and a nearly colourless solution was obtained, from which on adding more petroleum and allowing it to stand, groups of small needles were gradually deposited. Several fractions of the crystalline base were thus obtained and were recrystallised in the same manner. Finally, pure hyoscyamine was obtained in colourless, silky needles, melting at 105°.

Absence of atropine and scopolamine.

"***Absence of other Mydriatic Alkaloids.***—The small quantity of alkaloid precipitated along with the colouring matter by the first additions of petroleum to the solution in chloroform was also examined. The precipitate was extracted with very dilute hydrochloric acid, the solution filtered, and aurichloride added, when a yellow precipitate was produced which quickly aggregated to a resinous mass (fraction A); this was removed, and on adding more of the reagent to the filtrate a yellow, pulverulent precipitate was obtained, which did not aggregate on standing (fraction B). These two fractions were

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recrystallised separately from dilute acid from fraction A, two crops of crystals were obtained melting at 154—155° and 156—158° respectively; and from fraction B, crystals were obtained melting at 157—158°. The mother liquors from all these were concentrated in a vacuum and thus a few crystals melting at 146—149° were separated.

"All fractions of aurichloride insufficient for separate recrystallisation which had been obtained in the various experiments made were finally combined into two groups according to their melting points, 155—158° and 140—145° respectively. These were recrystallised as before, and virtually the whole of the gold salt was found to melt constantly at 159·5°. A very small fraction melted at 158—159°, and another from 150—155°, but these were too minute for further recrystallisation. The following are the melting points of the aurichlorides of the chief mydriatic alkaloids: atropine, 136—138°, hyoscyamine, 159—160°; scopolamine or hyoscine, 198—199°.

Hyoscyamine only present.

"There is, therefore, no evidence of the existence in this sample of **Hyoscyamus muticus** of any mydriatic alkaloid than hyoscyamine. We believe that the plant will prove to be an important source of this alkaloid, since it can be isolated from it with far less difficulty than from ordinary henbane (**Hyoscyamus niger**), which also contains the alkaloid hyoscine, and often atropine in addition.

Important source of the alkaloid.

"It should, however, be remembered that the nature of the alkaloids contained in atropaceous plants appears to vary with age, mode of cultivation, and other circumstances. Thus, in belladonna the proportion of hyoscyamine to atropine fluctuates widely with the age of the plant. It is, therefore, desirable that other specimens of **Hyoscyamus muticus** should be examined in order to ascertain whether hyoscyamine is invariably the only alkaloidal constituent.

Distribution of solanaceous alkaloids.

"It will be convenient to summarise here our present information as to the occurrence of hyoscyamine in various plants.

Hyoscyamus niger and **albus** (hyoscyamine and scopolamine).

Hyoscyamus muticus (hyoscyamine).

Atropa Belladonna (atropine, hyoscyamine and a little scopolamine).

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Datura Stramonium (atropine, hyoscyamine and a little scopolamine).

Duboisia myoporoides (hyoscyamine and a little scopolamine).

Scopola carniolica (hyoscyamine).

Scopola japonica (atropine, hyoscyamine, and scopolamine).

Lactuca sativa and **virosa** (hyoscyamine).

"The following percentages of total alkaloid have been recorded.

	Atropa Belladonna.	Datura Stramonium.	Hyoscyamus niger.		Hyoscyamus muticus.
			Biennial.	Annual.	
Roots	0·21—0·41	0·15	0·155—0·173	...	...
Leaves	0·30—0·90	0·12—0·20 (Av. = 0·49)	1st yr. 0·39—0·069; 2nd ,, 0·045—0·068	Leaves & tops 0·064—0·070	Stem & leaf. 0·1
Seeds	...	0·16—0·37	0·058—0·1	...	...
Stem	...	...	...	...	0·46*
Entire herb	...	...	...	0·03	...

"We are indebted to **Mr. E. A. Andrews**, Junior Assistant in these Laboratories, for the skilful help he has given in the conduct of this experimental work."

Since the appearance of the above paper in the Journal of the Chemical Society of London, **Dr. J. Gadamer** has communicated to a scientific periodical of Berlin ["*Archiv de Pharmazie* (236, 9, 704)] a preliminary note on the drug. The analysis reveals a remarkably high percentage of alkaloid in the leaves which is more than ten times the quantity found by the Imperial Institute investigators; the note, however, is interesting in confirming the presence of hyoscyamine in this species of henbane, and the following translation of it may be given:—

"The repeated poisoning cases that have happened in Egypt through the misuse of **Hyoscyamus muticus** as well as the stupefying exhalations of the plant have aroused the interest of **Dr. Kippenberger**, of Cairo, in consequence of which he kindly

* A misprint for 0·15 per cent. See page 7. (*ED.*)

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handed over to the Pharmaceutical and Chemical Institute of Marburg a large quantity of this solanaceous herb for investigation. The examination of the material sent which comprised about 3·5 kilos of seed capsules, 7·5 kilos of leaves, 5·75 of stems, and 0·75 kilo of root, was commenced in the beginning of last summer, but later on it was interrupted for some time because of other more important work. In the meantime Messrs. Dunstan and Brown have reported to the Chemical Society the results of their investigations into the composition of **Hyoscyamus muticus**. The conclusions so far obtained by me with respect to the Egyptian herb will now be briefly recorded, so that the right of further investigations into this interesting subject may be reserved to me.

Dr. Gadamer's experiments.

"I can confirm the statement of the above-named English chemists that the chief alkaloid of **Hyoscyamus muticus** (Egyptian) is hyoscyamine which can easily be obtained directly in a crystalline condition by evaporation of the chloroformic solution. Scopolamine could so far not be detected—up to date the investigations have been made only of the extract of the seed capsules. Out of the mother liquor a little atropine was detected, but the latter appeared to have been formed in the process of separation. The quantity of the alkaloid was found by the English experimenters to be 0·1 per cent., probably on the fresh plant. The dry material examined by me after C. C. Keller's method gave the following quantities per cent. of hyoscyamine:—

Seed capsules and seeds	1·34 per cent.
Leaves	1·393 „
Stems	·569 „
Root	·77 „

Further research will show whether the plant contains any other alkaloid than hyoscyamine. The volatile narcotic principle is not found in the dried material. The isolated hyoscyamine is sufficiently pure to allow of a study being made of its properties."

The chapter on **Hyoscyamus niger** in Prof. Dr. L. Lewin's *Lehbruch der Toxikologie* (pp. 344-46) might be read in connection with the subject discussed in the above pages.

G. I. C. P. O.—No. 985 R. & A.—12-6-99.—2,125.—H. R.

(Miscellaneous Series, No 4.)

THE AGRICULTURAL LEDGER.

1899—No. 6.

SYSTEM OF LEDGERING ECONOMIC INFORMATION.

A Note on the System of Ledgering Economic Information pursued in the Office of the Reporter on Economic Products to the Government of India.

By THE EDITOR.

INTRODUCTORY.

In the Office of the Reporter on Economic Products to the Government of India there has been organised a system of collecting and preserving (or as it has been called Ledgering) cuttings or extracts from Books, Pamphlets, Departmental Reports, Newspapers, Periodicals, Official and Demi-official Correspondence, etc., etc. The passages brought together contain additional facts regarding, or corrections on, the corresponding accounts of the products in question as given in the *Dictionary of the Economic Products of India*. The system of ledgering pursued is, in fact, that briefly indicated by the Government of India in the Resolutions (dated 20th March 1897) on the Proceedings of the Agricultural Conferences of 1893 and 1895 (Seventh Resolution, para. 4).

Ledger Headings.

2. Under that system every subject of importance receives a distinct heading, mostly the scientific name of the plant, animal or mineral concerned. The object may be said to be to bring together in one place, for convenient reference, all available information relating to one and the same subject.

Dictionary of Economic Products.

3. In the matter of choosing headings, the Dictionary of Economic Products is taken as the main, it might almost be said, the sole guide.

Every product, whether of animal, vegetable, or mineral origin, is in that work referred to its Scientific Name—English, Commercial or

Vernacular Names are given as cross references only or in the index. Being a dictionary the chapters or passages describing products are arranged alphabetically. While preparing that work it was felt that an arbitrary standard, such as that given by the scientific names, was preferable to any classification, however carefully and logically it might be worked out. The process of Ledgering new information is pursued as if directly intended to afford material for a revised edition of the Dictionary. The alphabetical assortment is, therefore, rigorously adhered to, and were there no other considerations it is believed the advantage of continuity of operations would far exceed any benefit that, here and there, might be secured by the introduction of an industrial or scientific classification. The main objection to an arbitrary standard, such as that followed, is the frequency with which authors and correspondents deal with products collectively. This is overcome, to some extent, by such passages being given in one position (that of presumed greatest importance) and cross references furnished under each of the other products that may be mentioned.

Revised Edition of the Dictionary.

Collective articles.

New Products.

5. When a subject brought under observation has not been dealt with in the Dictionary, the new heading, rendered necessary, is made to occupy the alphabetical position which it would very possibly take in a future edition of the Dictionary.

System of Files and Boxes.

6. The passages extracted from books, reports, correspondence, etc., are sewn into files or pasted on to blank sheets of foolscap paper,—previously prepared for the purpose in the form of files or small blank-books. These measure 14 inches by 9 inches and consist for the most part of 20 sheets. Between the sheets are sewn, here and there, tags of strong paper about two inches in breadth. To these tags printed matter (pamphlets, etc.) can be gummed or additional pages of blank paper interpolated as found necessary. The blank-books are deposited within strong card-board (or wooden) boxes that measure 15 inches long, 9½ inches broad and 4 inches deep, inside measurements. The lids and fronts of these boxes open by cloth hinges so that the blank-books may be readily got at. Each blank-book represents *one species*, but if there be more than one economic species in a genus, the various specific blank-books are placed within an outer *generic cover* of strong paper. In other words, the information collected is assorted in files and placed within boxes much after the

Species and Genus.

fashion of a herbarium of dried botanical specimens that had been arranged under their generic and specific names, but in place of being classified under their natural orders were distributed alphabetically. The boxes are numbered within each letter of the alphabet and placed on racks made for the purpose. The material already brought together in the Ledgers (belonging to this office) is comprised in 242 boxes.

Illustration of the System.

By way of illustration I may here discuss part of the contents of the first box on our racks. This bears on the end and outside, in large letters, **A. No. 1** and on a removable card (within a frame for the purpose) the words :—

Outside Label.

Abacosa
to
Abutilon.

On opening the box a loose sheet of paper is found on the top of the contents. On this has been gummed a slip of paper with :—

"**Abacosa** *Alef.* syn. for **Vicia,** *Linn.* see *Gen. Pl. I., 525 ; Index Kewensis, Vol. I., page 1.*

Scientific Synonyms.

Now the object of this loose sheet is to minimise the labour of discovering the modern scientific names of products. One of my staff may be supposed to be reading through a book or report and to have come across a passage dealing with **Abacosa.** He is at once directed by the Ledgers to the genus **Vicia** as that under which the information will have to be recorded. There are several other similar loose sheets, some referring to old synonyms (such as the example given), others to names that are employed by writers on economic products, but which cannot be identified in the works of scientific authors. The passages under these unidentified supposed scientific names are thus retained in their alphabetical positions until such time as they may be identified.

Unidentifiable Names.

Within the box we next come on a file or blank-book with written on the top right-hand corner (the position in which all specific names are written)

"**Abelia triflora,** *R. Br.*"

Cuttings from the Dictionary.

and below that the reference to the Flora of British India and to the Dictionary of Economic Products. On opening the file we find eight cuttings from books preceding and one following the passage

LEDGERS. — System of Ledgering

from the Dictionary. It is, therefore, to be presumed that the last-mentioned passage may contain new information. The older passages are, however, by no means rendered useless through the publication of the Dictionary. The author of the Dictionary article on **Abelia** may have misquoted a passage which he took from one of the cuttings within the file, or he may have considered an opinion recorded on another as hypothetical and therefore refused to quote it. The Ledgers are intended to be a complete record of all existing information, assorted within the files of each species in sequence of date of publication.

Complete Record of all Information.

Within the box, the contents of which are being examined is next found a generic cover with a large assortment of cross references and doubtfully identified information under the synonym "**Abelmoschus**". In most cases references are given to the species of **Hibiscus** concerned and the economic facts of each have been transferred to their proper places.

Generic Covers.

Next we come to a large generic outer cover with :—

"**Abies**, *Juss;* Fl. Br. Ind. V., 654;
Dic. Econ. Prod. I., 2."

on the left-hand lower corner (the position in which all generic names are written). On opening this we discover the following :—

(*a*) Loose sheet with "**Abies dumosa**, *Loudon;* Dic. Econ. Prod. Vol. I., 2, transferred to **Tsuga Brunoniana**, *Carr.* in conformity with Sir J. D. Hooker's determination in Fl. Br. Ind., Vol. V., 654.

(*b*) "**Abies excelsa**, *DC.;* Dic. Econ. Prod. Vol. I., 2, transferred to **Picea excelsa**, *Link.*

Rearrangements of Files.

(*c*) "**Abies Smithiana**, *Forbes.*, Dic. Econ. Prod., Vol. I. 3—4, transferred to **Picea Morinda**, *Link.*

(*d*) **Abies Webbiana**, *Lindley.* Dic. Econ. Prod., Vol. I., 4—6.

Within the file of the last-mentioned species there are gummed and arranged in sequence of date of publication twenty-nine passages prior to the Dictionary article, and nine passages subsequent.

It will thus be seen that accepting the Flora of British India as the standard for botanical names, three corrections in the synonymy of the Dictionary have been effected, and the information regarding the remaining species somewhat amplified. *The Fauna of British*

India has similarly been accepted as the standard for the names of animal products and the Publications of the Geological Survey of India, for mineral products.

Passing over many unimportant loose sheets of synonyms, a file on the collective article **Abir** is found. This may be viewed as an example of a product of two kinds, (*a*) a collective article such as Abir itself, a substance which is made from entirely different materials in the various Provinces and Districts. Of this nature also might be mentioned Millets, Pulses, Fibres, Dyes and Tans. Many authors write in such a way that it becomes impossible or doubtfully advisable to attempt to cut up their publications under specific headings. It is therefore necessary to have certain collective headings such as those mentioned. But under the names of each of the substances of which Abir is made or of the various species of millets, etc., etc., a cross reference would be recorded as follows "see ,Abir" see Millets, etc. So again (*b*) products that cannot be identified have to be dealt with under their English or Vernacular names. This should of course be regarded as only a provisional arrangement. When determined they would be transferred to their true positions according to their scientific names.

Collective articles.

Provisional Positions.

In the box under examination we next come on **Abroma augusta,** *Linn.*

This is treated in precisely the same manner as all the other examples, with this difference that a special effort has been made to collect information by a Circular letter No. 16 of 1894-95. That Circular may be said to have analysed the Dictionary article, pointed out its defects para. by para., and asked for additional information and specimens.

New Information Procured by Circular Letters.

In consequence, following after the Dictionary article will be found *The Agricultural Ledger* No. 6 of 1896 (a publication that made known the new information up to date of issue) and in manuscript a fairly extensive series of letters in reply to the Circular above quoted. The available information has thus been greatly improved and the file within the ledger box thus contains much additional material to that given in the article Abroma in the Dictionary. Amongst other facts a paper by **Dr. Roxburgh** on its fibre (written in 1801) has been brought to light which had not been discovered at the time the Dictionary account was written.

LEDGERS. System of Ledgering

The above illustrations will, I think, abundantly exemplify the method pursued both in filing papers, correcting errors, and in procuring special information by Circular letters and otherwise—information which is from time to time published in *The Agricultural Ledger.*

Animal and Mineral Products.

Of course had an animal or mineral product fallen within the papers discussed by the above notes, it would, in its own proper place, have been dealt with in precisely the same manner as with vegetable products.

Procedure.

7. Having thus briefly detailed the method of recording information, attention may now be turned very briefly to the procedure followed in discovering useful particulars regarding products and manufactures.

Official Publications.

All Government Departments in India are supposed to send three copies of their Annual and other Reports to this office. Many of the Colonial Governments and also the Governments of America and of most countries in Europe, send Reports, Bulletins and other such publications that have a bearing on economic products, in exchange for this Department's publications. We also receive a fairly complete series of the Consular and other Foreign Office reports. These as obtained are gone over by certain clerks in the office and passages that deal with Indian economic products are marked.

Passages marked.

In due course these are submitted to me through the Superintendent of the Ledgers. If of sufficient importance I assign the heading under which the passages are to be deposited in the Ledgers. In the same way the leading Indian Newspapers and a selection of the more important European, American and Australian Newspapers and Periodicals are read and passages from them ultimately cut out and ledgered.

Newspapers and Periodicals.

Books of travel, Gazetteers and other special works are from time to time taken up and read through, and all the passages that deal with products recorded on specially printed slips that give the title of the work, date of publication, page and other useful facts of a general nature followed by space for name of product and abstract of information.

Printed Slips.

Where it is possible to obtain three copies of books, etc., one is placed in the Library for future reference, and the other two are cut up and the passages regarding products after being gummed on to slips showing title of work, etc., are carried to their respective places.

Books cut up.

This is infinitely the more satisfactory course, the actual passages being thus preserved and the labour and risk of error in copying obviated. Unfortunately some Departments send only two copies of their reports and it becomes

extremely difficult in such cases to obtain the actual original printed passages, since one product may be dealt with on one side of a sheet and another on the reverse. One copy for cutting up is thus insufficient.

Correspondence in relation to the Ledgers.

8. In conducting correspondence on Economic Products the system pursued by me is to make the Ledger headings as far as possible the subject headings of every letter issued. But the greatest possible difficulty is often experienced. The chief object of correspondence, so far as this Office is concerned, is the collection of information. After a certain date the letters that contain useful particulars (not routine notes, formal acknowledgments, etc., are bodily transferred to the Ledger files. But it only too frequently happens that local officers, who may have been asked for information at various times, regarding two or more products, send a combined reply. In consequence their letters have to be copied ever so many times (or the passages in them that deal with the several products have to be copied), and placed in our specific files. We may acknowledge each separately, but the further replies may again combine the products, or perhaps add others that have been discussed in subsequent communications. I have gone into these details since officers who may desire to open up provincial ledgers will most assuredly experience this difficulty when they attempt to carry correspondence into the ledger files. There is one escape from the confusion that I have indicated, namely, for communicating officers, when unable to frame separate letters on each subject, to issue a covering letter to a whole series of appendices, each appendix dealing with only one product. This, I venture to think, would entail comparatively little extra labour on the officers on whom I have so very largely to depend for the new information that is being brought to light. Each appendix could then be carried to its respective place, with simply the number and date of the covering letter recorded on it by my office. The whole series could still be retained as one letter (by the local officer) and thus prevent what to him may be an unnecessary and troublesome multiplication of files and registration of letters.

Correspondence placed in Ledgers.

Serious Difficulty.

Most Satisfactory Course.

Covering Letters to Special Reports.

9. But in addition to the collection of useful information, opportunity is also taken to procure specimens. It often happens that local officers on whom demands have been made for certain vegetable products are in doubt as to the correctness of their determinations

Preparation of Specimens.

of the articles required. In every such instance encouragement is given to communicate in the first instance dried botanical specimens (preserved according to the instructions conveyed by *The Agricultural Ledger* No. 4 of 1894). On these coming to hand they are examined, and, if correct, the required products are called for; if incorrect, a further effort has to be made, but to assist the local officer a botanical specimen of the plant in question may sometimes be forwarded for guidance. The botanical specimens, as also the economic products subsequently furnished, are then registered, the former (if required) are mounted and deposited in the Economic Herbarium, the latter are placed in the Indian Museum and duplicates perhaps issued to other Museums in various parts of the world. On a visitor to the Indian Museum desiring to obtain information regarding a particular product that may have attracted his attention, in any of the galleries, he is conveyed to the Commercial Consultation Room. The Dictionary number and the individual registration number, having been written down on a slip of paper, the original botanic and economic specimens as also the ledger files (showing the actual correspondence) can be placed in his hands within a few minutes. It will thus be seen that the Ledgers are but one link in a far-reaching scheme of investigation, though doubtless a most important one. The basis both of the Museum and of the Ledgers is thus the Dictionary of Economic Products. All publications issued by this office are accordingly given under the scientific name and Dictionary number of each individual product. Each such pamphlet, however large or small it may be, is thus issued by itself with the two-fold object of amplifying the particulars given in the Dictionary article of that particular product and of allowing of its being at once placed in the ledger files of the species in question.

Registration of Specimens.

Economic Herbarium.

Practical Results.

The Ledgers are therefore viewed as public property quite as much so as the collections in the Museum. They can be consulted by visitors to the Museum who may desire to do so, subject to one qualification, *viz.*, that only one product is sought to be examined at one and the same time. The files regarding many products are naturally by no means complete at the present moment, since before that most desirable result can be attained each product requires to be taken up for special enquiry throughout the Empire. But as exemplifying the nature of the ledger files on economic products I

Present Condition of the Ledger Files.

Rhea File.

may here instance one series, *viz.*, those on Rhea or China grass—**Bœhmeria nivea**. The passages from books, reports, newspapers and correspondence on this subject are comprised within seven boxes of the size already described. The information thus brought together extends from 1705 to 1899 A.D. and may be accepted as giving every article of any importance (so far as has been discovered) that has appeared on this subject in India, Europe, America or the Colonies. The merchant or student who may desire to study this fibre should thus find these files to contain all the particulars that he is ever likely to desire, besides giving him a ready reference to a fairly extensive series of specimens in the Museum and Herbarium cabinets devoted to this product.

Classification in the Museum.

10. If the Dictionary of Economic Product be consulted it will be found that the account given of each product has been referred to certain industrial sections. Should a product afford a GUM or RESIN the available information on that property constitutes the first industrial paragraph. Then comes the heading OLEO-RESINS, OILS and OIL-SEEDS; next DYES and TANS; then FIBRES and FIBROUS MATERIALS, MEDICINES and CHEMICALS; FOOD SUBSTANCES and FODDERS; TIMBERS; MINERALS and lastly, DOMESTIC and SACRED ARTICLES (or Ethnology). The Economic Museum has similarly been referred to these industrial sections so that a visitor interested in fibres does not require to wander all over the building in order to study the fibres of India. Within each section for example FIBRES the collections have been arranged alphabetically and according to the numbering pursued in the Dictionary, so that the Dictionary has become the Museum Catalogue. The fact that certain numbers are missing (owing to their representing products shown in other sections than that devoted to fibres) is found to be no inconvenience. The numbers that do appear as fibres are progressive, and that suffices for rapid reference.

Disposal of Special Works or Pamphlets.

In the Ledgers it has been found desirable to open up collective headings such as those indicated above as the sections of each article in the Dictionary and the industrial bays in the Economic and Commercial Museum. A work like Dr. H. McCann's Dyes and Tans of Bengal may be cut up and the passages in it that deal with Indigo carried to **Indigofera**, but there are many useful chapters that cannot readily be distributed under specific denominations. It, therefore, becomes desirable to preserve a copy of the work in its

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collective form. This may be either deposited in the dye section of the Library and a reference given within the ledger box to the work, or if it chanced to be a small pamphlet (apt to be lost in the Library) it is safer to be preserved in the ledger box on Dyes and Tans. In course of time the pamphlets deposited in the collective sections are bound into volumes and placed in the corresponding sections of the Library. I have alluded to these particulars regarding collective articles, because, while it is desirable that all information should be brought together under specific headings, collective headings are to some extent unavoidable. Success in Ledgering information regarding Economic Products may, however, be said to be indicated by the paucity of collective headings.

Success in Ledgering.

Correspondence Files.

11. In conducting correspondence it is necessary to assign numbers to the files as well as an annual serial for general registration of individual letters. Without some such system papers on the same subject would not be brought together and they could never be found when required. In the Dictionary of Economic Products from the beginning of "A" to the end of "F" there are 7,597 separate topics discussed, most of which may be taken as represented by products. Obviously, therefore, it would be impossible to adopt the Dictionary numbers for file purposes. It was early recognised as imperative that some less voluminous system should be devised. It accordingly seemed to me that in the Industrial Classification pursued both in the Dictionary and in the Museum, the key might be had to a satisfactory classification and registration of files of correspondence. Some years ago I accordingly assigned fixed file numbers for all the important products and grouped these as follows:—

Gums and Resins.—The more important products of this class, such as India rubber (No. 32), Cutch (No. 34), Gum Arabic (No. 35), Lac (No. 36), etc., had each the above-noted separate file numbers allotted to them, while the unimportant gums and resins were grouped under a common file designated "Gums and Resins not specified, No. 43." So in the same manner with the **Oil-seeds and Oils**; with the **Dyes and Tans**; with the **Fibres and Fibrous Materials**, etc., etc.

In this way the papers temporarily preserved in the correspondence branch are dealt with under an approximately parallel system to that pursued in the Museum, in the Ledgers and in the Publications

issued from my office. But the file numbers, employed in correspondence, are essentially temporary. As soon as sufficient material has been brought together under any subject, the important papers are removed from the correspondence files and transferred to the Ledgers under the scientific name and Dictionary number for the products in question.

The Agricultural Ledger.

12. The periodical which has come to be known as *The Agricultural Ledger* gives publicity from time to time to the information being brought together. The original intention was simply to issue by means of that publication (to provincial and other officers who might deem it desirable to establish Ledgers, new and useful information on the products of India that had been procured by the Imperial office. Each issue of the Ledger was accordingly intended to deal with one subject only, so that it might be at once deposited in all the Economic Ledgers established throughout the Empire. There was no provision made for the various issues of the Ledger being ultimately bound into annual volumes, since that was not contemplated as being likely to be required. It was, however, felt that it might be both desirable and economical to adopt some classification that would bear a distinct relationship to the industrial sections already discussed, while facilitating distribution to special departments. The Seventh Resolution of the Government of India (to which reference has been made in the opening paragraph) provides that the Botanical Department, the Veterinary Department, the Forest Department, the Geological Survey, the Agricultural Departments, the Agricultural Chemist, the Bacteriological branch of the Veterinary Department, and the Entomological Section of the Indian Museum may each make available for publication in *The Agricultural Ledger* useful economic information for which it was desired to ensure a distribution among officials and others who might not be privileged to see the detailed publications of the departments named. It would accordingly have been both next to useless and unnecessarily expensive to issue (for example to persons interested in Veterinary Science) a promiscuous collection of papers on Forest Produce, on Economic Minerals, etc., etc. A classification became essential even although it might involve to the few persons and departments furnished with copies of all the issues of the Ledger a complexity greatly to be deprecated. It was

presumed that the various sections of the Ledger might be bound separately as sufficient material accumulated, but while, perhaps, only one or two small pamphlets appeared annually under one section, sufficient to make a fair sized volume might be published under another. In view of the presumption that the issues of the Ledger would be at once deposited in provincial Ledgers and be quoted as distinct papers, each was paged by itself instead of a folio being continued from year to year until the sectional volumes had been completed. Briefly, the Ledgers were issued for a specific purpose to which they were directly adopted.

The Agricultural Ledger.

But experience during the past few years has shown that *The Agricultural Ledger* meets a demand of a much more extensive character than originally contemplated. Applications for it have been received from all parts of the world, and within India itself the planting and mercantile public have indented for the special issues to such an extent that it has been found necessary to affix a charge for each pamphlet and to place the sale of these in the hands of the trade. At the present moment the list of free distribution comes to 2,200 copies. It is now a question for consideration whether it might not be desirable to give a continuous annual folio on the top corners of the pages and a sectional folio on the bottom corners, so as to allow of the pamphlets being either bound in annual or in sectional volumes as thought desirable by subscribers and others who do not intend to use the pamphlets as originally designed, *viz.*, as additions to the accumulation of papers in their provincial or departmental ledgers.

G. I. C. P. O.—No. 58 R. & A.—3 7-99.—2,225.—G. R.

(Veterinary Series, No. 28.)

THE AGRICULTURAL LEDGER.

1899—No. 7.

OXEN.

[*Dictionary of Economic Products, Vol. V.*, O. 551-94.]

THE CATTLE OF KUMAON.

Note by VETERINARY-LIEUTENANT G. K. WALKER, *Assistant Imperial Bacteriologist, Muktesar, N.-W. P.*

INTRODUCTION.

Similarity to Kerry-Dexters.

The domestic cattle of Kumaon are strangely similar in appearance to the Kerry-Dexter cattle of Great Britain and Ireland and present many interesting features.

The indigenous cattle of the respective "Parganas" of the Almora and Naini Tal Districts vary somewhat, but the main differences are in size and the attendant qualities in regard to milking and working properties. The inhabitants of the hills, adjoining the plains in the Naini Tal and Almora Districts migrate annually during the cold weather to the plains (Bhabar), and take their cattle and buffaloes with them using them sometimes as transport.

In this way these cattle have become crossed with plains cattle and are not in the least typical of the true hill species.

Stud bulls have been placed in the Bhabar for the purpose of crossing and the results have produced valuable cattle.

Typical appearance of animals in the interior of Kumaon.

In the interior of Kumaon the cattle present a typical appearance. The inhabitants differentiate between the cattle belonging to the several "Parganas" to which they belong, but the different characteristics are very slight in pure bred Kumaon cattle.

The cattle of the Parganas Chougarkha, Bárámandal and Kattyor are larger and more valuable than those of Gangolee, Sor Askot, Sirá and Dánpur. In Pallee Pachaon they are even larger and a good class is produced in "pattee" Sálam.

OXEN. **The Cattle of Kumaon.**

GENERAL CHARACTERS.

They are small in size, compact and short in the leg, the hump is small and in some cattle hardly appreciable. They are very active and as a rule extremely wild. The head is well shaped and carried low, broad between the eyes, and the forehead slightly concave. The muzzle is broad and usually black in colour with large nostrils. The horns are small and not artificially interfered with. The ears are large and carried horizontally to the head. The eyes are full, usually hazel in colour with long lashes. The neck is short and thick. The dewlap is not very evident and very poorly developed in comparison with Indian cattle in general. The hump, as above stated, is characteristically small. The back is fairly straight rising gently to the croup. The loins are narrow and slightly slope towards the tail, but the slope is not excessive as a rule. The tail may be described as well placed on the body. It is long and tapering and has a tuft of hair on the end. The shoulders are fairly well sloped. The chest is deep and wide. The arch of the ribs is well rounded and the cattle are usually well ribbed up. The limbs lack bone, but the fore-arms and thighs are fairly muscular. The sheath is small and close. The feet are small, hard and well-shaped. The skin is usually dark in colour generally thick and well covered with hair. The predominating colours are black, black brown, brown and red, but broken colours are not uncommon, grey and roans appear to be scarce.

Working powers.

The male is used for ploughing purposes. Their working qualities must be termed poor as many refuse to work, and they lack substance and strength. The majority are far from docile, and the bulls fight a good deal among themselves.

Milking properties.

Zemindars' cattle are poor milkers. The cows give from one-fourth to two seers a day. Occasionally an exceptional cow may give as much as four seers. The best milking cows come from the Pallee Pachaon Pargana (Ranikhet Cantonment). Good hill cows may also be obtained in the Chaugarkha Pargana. Though the quantity of milk is small its quality is good, taking into consideration the feed is as a rule only grass, 12-14 quarts go to 1lb of solid butter.

Feeding.

Zemindars' cattle get only what they can find on the hill sides during the day. Stall-feeding is not practised except on cattle too weak to graze with the herds. Grass may be collected after the rainy season and packed in trees for use sparingly in the cold weather.

The Cattle of Kumaon. (*G. K. Walker.*) OXEN.

CATTLE FODDER.

Village pasturage is decidedly poor. There is, however, grass to be obtained on claimed grazing grounds, but if water is not near a hand, these pastures are not made much use of.

Grasses.

The following are the vernacular Names for some of the most common grasses recognised by the natives of this vicinity (Muktesar)—

Kumariyá **Andropogon contortus** (Spear grass).
Shiro . **Imperata arundinacea** (Ulu grass).
Salim . **Andropogon Gryllus**, *Linn.*
Bimalsiyá **Pennisetum orientale** *var.* **triflorum** (Cumboo* millet).
Gweriya . **Andropogon monticola** *var.* **Trinii.**
Piriya . { **Andropogon Nardus**, *Linn.* / **A. Nardus**, *Linn.*, *var.* **flexuosus**, *Hack.*
Gajeo . Used loosely.
Malsá . Appears to be used loosely for **Agrostis, Alopecurus, Festuca,** and other well-known English grasses which are rather plentiful after the rains on cultivated land.

Cattle are very fond of the young shoots of the grey and green oak (*bánj* and *phalyánt*) and these are cut by the villagers for the purpose of feeding. Ringal or Himalyan bamboo **(Arundinaria falcata)** is also a staple food for cattle when obtainable.

Fodder.

The ears of the summer crops are usually removed first and the straw of paddy, *madwá*, *mandira*, etc., is then cut and stacked in trees for use in the winter for forage and bedding purposes. The straw of the winter crops (wheat, barley, etc.,) is usually cut with the ear, not close to the ground, and the grain having been threshed the bhoosa is given to the cattle, any straw remaining is eaten off by cattle.

In Pallee Pachaon, they, however, use this straw for making matting.

Housing.

The cattle are usually kept at night under the living rooms, but they are also often stalled in chuppars which are sometimes very

* **Pennisetum typhoideum** is Cumboo millet (*Bajra*), not the wild species mentioned above.—G. Watt, *Ed.*

OXEN.	The Cattle of Kumaon.
REARING.	warm and comfortable. During the hot weather and rains cattle may be tethered outside the sheds, provided there is no fear of panthers.
Calves.	The calves are allowed all the milk for the first few days, after that they get half quantity. The vernacular name for bull-calves is "baharà" and for cow-calves "bachiá." Yearlings are called "Sálana," and two years old "do sál."
Cattle-markets.	There are no cattle markets.
Prices.	The prices vary considerably, *viz.*, from R4 a head to as much as R25 for good milch cows or exceptionally good working bulls. It is exceptional, however, for any animal to realize more than R15. The Gangolee class of cattle are the cheapest, costing from R5 to R12 each. Chaugarkha and Bárámandal cattle fetch from R8 to R18 and the Pallee Pachaon cattle cost from R10 to R25 per head.
Age.	Age is judged by the teeth and horns.
Shoeing.	No hill cattle are shod.
Castration.	There is no regular castration, but some animals are operated on by mulling. This consists of destroying the glands by blows after having deadened the part by friction. The operation is usually very successful.
Carcases.	Skins are taken off by "dooms" and sold to mochis for R1 to R2-8 each. The flesh is eaten by dooms or low caste people if fresh, otherwise it is left for vultures, jackals and wild pigs to devour. Occasionally carcases are buried.
Dung.	The dung is used for manure or mixed with clay for plastering houses.
Diseases.	Rinderpest and Foot-and-Mouth Disease are common as epidemics.
Medicines.	It may safely be stated that no medicines are employed for combating disease. For wounds infusion of cherry tree bark is occasionally applied, and turpentine for Foot-and-Mouth Disease.
Breeding.	There is no such thing as systematic breeding. Herds get mixed when out grazing and a good cow may be served by a wretchedly bad bull. General Ramsay, when Commissioner of Kumaon, introduced Hissar bulls to the Bhabar, and these were taken advantage of. Local zemindars in the Bhabar possess some good bulls, and the people use these in the cold weather when they take their cattle down.

The Cattle of Kumaon. (*G. K. Walker.*)

OXEN.

BREEDING.

Hissar bulls.

Odd Hissars bulls have been imported into the interior from time to time. One located at Kausanni was popular and made use of. **Mr. Stevenson**, of Berenag, tells me he was once supplied with a Sind bull by **Colonel Garstin**, and it was in great demand. A Brittany bull he also sent was not liked having, **Mr. Stevenson** says, nothing in its favour.

Cows are supposed to breed after 3 years old, but some probably breed earlier.

Abortion.

Abortion cannot be common as I am told it does not occur.

Importance of using good bulls.

I myself have not yet seen a really good bull of the indigenous breed suitable for breeding purposes. This is a matter of importance if the breed is to be improved. It appears necessary, if anything is to be done in Kumaon, to improve the breed in the future, to import bulls and to establish shows. In a certain space of time, suitable Cross-bred bulls, which have taken high places in local shows, would be suitable for breeding purposes, and I believe the natives of Kumaon would use and appreciate them. Castration would have to be encouraged, of course, and then these special bulls would probably answer their purpose if allowed to run loose with the village herds. That something should be done to improve the breed is manifest as the indigenous breed is small for agricultural purposes, and the quantity of milk supplied by even good cows ridiculously small.

Shows advocated.

Cross-breeds.

The chief present crosses are between hill and Bhabar cattle. The results, though occasionally weedy, are very much more valuable than the indigenous hill, as they give more milk and are larger and therefore more useful for agricultural purposes. Judicious crossing by the importation of suitable bulls, should be of great benefit to Kumaon cattle, as these, though hardy and active, are wanting in size. Even the indigenous cattle fall away a good deal in the cold weather, unless kept exclusively to the warm valleys, but this is due more to bad and scanty food and insufficient housing than anything else. There is no reason to suppose that cross-bred cattle should not stand the climate quite well if properly cared for. **Mr. Stevenson** has had Sind, Hansi, half English, half Hansi and Brittany bulls and has kept Hansi, Amritsar, Muttra and other plains cows for breeding purposes and his cattle are excellent workers and milkers. He only gives grain to cattle in milk, the rest are grazed.

VERNACULAR NAMES OF DISEASES.

Rinderpest	*Mán.*
Foot-and-mouth disease	*Khuria.*
Dysentery	*Pechis.*
Paralysis	*Báyu-ki-bimári.*
Ringworm	*Dád.*
Constipation	*Pet phulgia.*
Catarrh	*Sardi, Jukám.*
Debility	*Kamzori.*
Jaundice	*Kamal bayu.*
Epilepsy	*Jhánká.*
Pneumonia	*Kaphpit.*
Dyspepsia	*Bad hazmi.*
Abortion	*Tujiun.*

The Cattle of Kumaon. (*G. K. Walker.*)

OXEN.

Sex.	Age.	Height at shoulder.	Height at croup.	Height at elbow.	Length.	Length of horn.	Length of ear.	Length of face.	Breadth of forehead.	Shape of forehead.	Girth at chest.	Girth at abdomen.	Girth of forearm.	Girth of shank.	Length of neck.	Length of shank.	Colour of skin.	Colour of hair.	Remarks.
	Years.																		
Bull . .	6	36	37	21	31	6	7	15	5	Concave.	46	50	9	4½	19	4½	Brown.	Red.	Gangolee.
Do. . .	5	35	35½	20	30	7	7	15	6	Do.	46	46	9½	4	15	5	Do.	Do.	Do.
Do. . .	6	34	34	20	34	7	6	14	6	Do.	46	57	10	5	14	4½	Do.	Do.	Do.
Do. . .	5	34½	35	21	31	6	6	14	6	Do.	45	51	9	4½	17	4½	Do.	Do.	Do.
Do. . .	5	35	35½	21	30	5	7	14	6	Do.	44	49	10	5	17	4½	Do.	Black.	Do.
Do. . .	7	36	38	21	33	6	7	14	6	Do.	50	50	10	5	20	5	Do.	Dark brown.	Do.
Cow . .	6	36	37	20	36	broken.	7	14	6	Do.	53	60	11	5	18	5	Do.	Black.	Do.
Do. . .	6	39	40½	21	35	9½	8	17	5	Do.	57	60	12	6	21	5½	Grey.	Grey.	Dánpur.
Do. . .	8	36	37	20	34	broken.	6	14	5	Do.	48	51	9½	5½	15	5	Brown.	Red.	Chaugarkha.
Bull . .	8	41	42	24	36	8	7	17	7	Do.	57	60	13	5½	20	7	Black.	Black.	Baramandal.
Do. . .	7	41	41	21	37	11	7	18	6	Do.	53	58	10	5½	21	7	Do.	Do.	Do.
Do. . .	5	43	43	24	40	8	7	17	7	Do.	54	56	12	5½	23	7	Do.	Do.	Salum.
Cow . .	6	40	41	24	37	8	7	18	6	Do.	55	56	12	5½	21	8	White.	Grey.	Bhabar cross.
Do. . .	6	38	39	21	29	17	8	16	6	Do.	51	54	9	5	16	6½	Do.	Do.	Do.

O. 551-94.

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(Veterinary Series No. 29.)

THE

AGRICULTURAL LEDGER.

1899—No. 8.

OXEN.

[*Dictionary of Economic Products, Vol. V.*, O. 551-94.]

MEASUREMENT OF CATTLE IN EUROPE.

The improvement of Cattle in the centre of Europe, and more particularly in the Grand Duchy of Baden by a system of measurement. From the French of PAUL CAGNY (*Recueil de Médicine Vétérinaire*) *translated and summarised by* VETERINARY-LIEUTENANT G. K. WALKER, *Assistant Imperial Bacteriologist, C. V. D. To which is added a Prefatory Note by* VETERINARY-CAPTAIN W. D. GUNN, *Superintendent, Government Cattle Farm, Hissar.*

PREFATORY NOTE.

As at the present time much more attention is being devoted to the important subject of the improvement of cattle breeding in this country than was formerly the case, and this pamphlet comes to us at an extremely opportune time. The ingenious system advocated by Paul Cagny, the author, is very simple, and with certain modifications might be altered to suit the requirements of Indian breeders. Of course his measurements from the withers, back, and croup to the ground would be different from those obtainable from the Indian breeds which have a totally different contour of back and which is peculiar to the Tebu type. It must, however, be remembered that this type is in particular favour with Indian agriculturists. The other measurements, such as the depth of girth, breadth of girth, and width of hips, are very important, and in breeding cattle the utmost attention should be given to these points. The levelness of the back is a minor consideration in comparison with a round deep chest and

PREFATORY NOTE BY CAPTAIN GUNN.

broad loins. It is with regret that it must be conceded that the Cattle of India, once renowned for their power and endurance, are fast degenerating into narrow-chested, leggy, narrow-loined animals, quite unfit to do the work that their grandsires did, and it is with the object of preventing this utter degeneration that the Civil Veterinary Department is taking such a deep interest in this matter.

India possesses five breeds of cattle.

That there are still five breeds in this country is evident to everyone who takes an intelligent interest in cattle, and it is only necessary to inspect a siege train battery to show what magnificent animals the country is capable of producing with careful breeding.

It is too much to anticipate that our Indian agriculturists will understand or appreciate the more complicated measurements, but they do thoroughly understand the value of deep, broad chests, wide hips, and the power of traction.

Bengal cattle. Ordinary tests of endurance.

At some of the Cattle Fairs in Bengal, one of the common tests is the ability of a pair of bullocks to draw heavy loads. It is no uncommon performance for a pair of good bullocks to draw a load of sixty-five maunds, and in agricultural contests, these performances afford the utmost interest and are greeted with the greatest applause.

Greater care formerly paid to breeding.

Before the introduction of railways into India, when the chief means of transit was the bullock, much attention was paid to breeding fine strong bullocks, and with this object in view it was customary to set apart the finest and most powerful of the young males, and to eventually turn them into the herds as bulls. To make the custom popular, it was made into a religious ceremony and the dedication of the male calf was known as "Poon." It is noticed with deep regret that this excellent custom has now degenerated into a meaningless ceremony, and worthless creatures are turned loose to the great detriment of the herds.

Possible improvement of Indian cattle.

If cattle breeders in India would more particularly direct their attention to developing the width and depth of chest measurements and the width of the pelvis, they would soon possess breeds of cattle which all the world might envy. The forethought of the Government of India in providing a breeding establishment for bulls will no doubt do much to prevent the downward tendency, particularly if special attention is directed to the points already noted, *viz.*, the development of chest and quarters. Veterinary-Lieutenant Walker is to be congratulated upon bringing this most interesting subject to the notice of those Indian readers who are interested in the subject.

THE GERMAN SYSTEM.

INTRODUCTION.

The author attended the National Agricultural Exhibition of the German Empire near Stuttgart in June 1896 and was much struck with the system of improving breeds by measuring cattle. The system owes its inception to **Dr. Lydtin,** Chief Veterinary Surgeon in the Grand Duchy of Baden, and it is obligatory in the competitions in the Grand Duchy. It has since become obligatory in Wurtemburg, Prussia, Oldenburg and Frise and is about to be adopted in Switzerland, the Grand Duchy of Luxemburg, Bohemia, Hungary, etc.

Discoverer of the system.

The author has followed the progress of the movement since 1885 and aims to introduce it in France.

Method of improvement.

Towards 1870, **Dr. Lydtin** after an understanding with several influential agriculturists, took upon himself the task of improving their cattle. Numerous meetings of breeders were held and the breeders were told that, "If you wish to create a market to attract buyers, it does not suffice to bring good animals. It is necessary that the animals do not consist of a mixed stock. On the contrary, they should consist entirely of one kind. Choose the breed that you find the best local conditions for, *viz.*, climate and food, and produce them there. Offer for sale only specimens of that breed. You will then attract to the market only buyers of that kind of breed, it is true, but you are certain to get them there. Offer, on the contrary, 100 animals of different breeds, you will probably attract no one. The buyers of each of these breeds will be particularly afraid, with reason, of not finding a sufficient choice."

The above was explained in articles in the journals and in pamphlets distributed gratuitously, and soon the breeders understood that to thrive it was worth giving up breeding according to their personal ideas. To obtain the production of the same breed and to assure the unity of the market, the breeders began to form syndicates among themselves. The members then submitted their cattle to inspection and a principle of selection based upon the system of measurement to be described.

CATTLE REGISTERS.

The registers are held by the mayors and Veterinary Surgeons. According to law, parishes ought to provide breeders with choice bulls. These are under the superintendence of the Veterinary-Surgeons together with the number of cows to be served, their lodging

THE GERMAN SYSTEM.

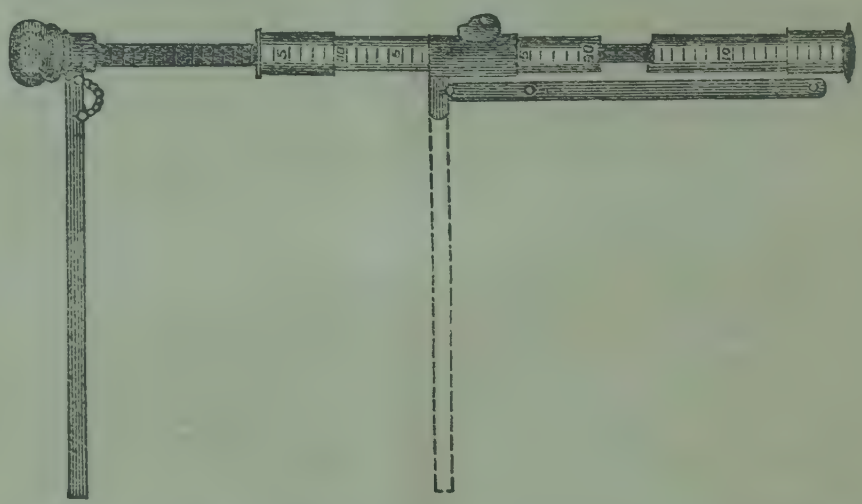
and their food. Several of these places were visited by the author, and he states the arrangements to be simple, practical and inexpensive. The system of common bulls is now-a-days obligatory in the Grand Duchy of Baden, Wurtemburg, Bavaria, Hesse and several Provinces of Prussia.

The Principle of the Method.

Dr. Lydtin elaborated a principle of measurement to abolish in a practical manner mediocrity as follows:—cattle intended for the butcher ought to have the following qualifications:—

Straight back, great length of body, breadth and depth of chest and breadth of pelvis. In order to do this he modified the measuring standard usually adopted for animals. Instead of using one horizontal rod on the vertical upright, he employed two so that he can expand or close them according to the measurement of the width of the body. The lower horizontal has a hinge so that when not required it can be applied to the vertical and thus be put temporarily out of use.

Description of measuring rod.



How used.

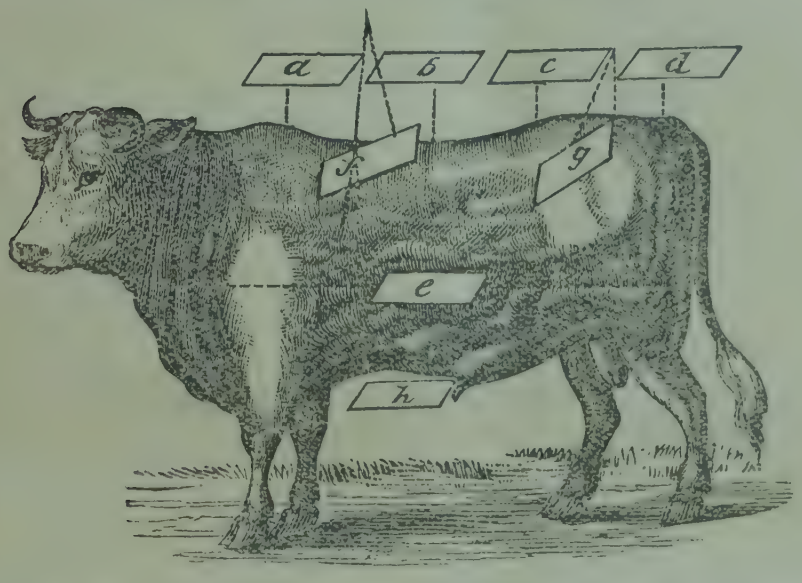
In order to see if the back is straight, the height is first taken at the withers, then in the middle of the back, then at the entrance of the pelvis (croup) and then at the root of the tail. This done, the two horizontal rods are brought into use. The length of the body is taken from the point of the shoulder to the back of the buttock, then the width of the sides behind the shoulders and finally the width of the pelvis at the level of the coxo-femoral articulations, and the

N.B.—The ordinary measuring standard can be used. The only addition required is an extra horizontal sliding rod. When not in use this can simply be slid off the vertical pole. The instrument is very much like a magnified shoe-makers' foot measure.

Measurement of Cattle in Europe. (*G. K. Walker.*) | **OXEN.**

THE GERMAN SYSTEM.

height of the chest (from the ground). These measurements are found sufficient for the general run of animals.



Results of experiments with good ordinary cattle.

Experiments made upon animals considered ordinarily good caused the following proportions to be established :—

Let a=height at withers.

N.B.—This measurement would have to be taken behind the hump in Indian cattle.

b=height at middle of back.
c= „ „ croup.
d= „ „ tail.
e=length of body from shoulder to buttock.
f=breadth of sides behind shoulders.
g= „ „ pelvis at hip-joints.
h=height of sternum from ground.

Then—

b is at least equal to a—0·02 m (= metres).
c is less than a+0·04 „
d „ „ „ a+0·10 „
e „ at least equal to $a+\frac{1}{10}$ of a.
f „ „ „ „ $\frac{1}{3}$ of a.
g „ „ „ „ $\frac{1}{3}$ of a.
h „ „ „ „ $\frac{1}{2}$ of a.

N.B.—The relations of b, c, and d to a are somewhat difficult to follow and appear unnecessarily minute. It probably would suffice if a, b, c, and d were required to be as nearly equal as possible. The thing, however, requires practically working out amongst the different breeds and a proper standard of measurements made for each. Given that the height at the withers (behind the hump in Indian cattle) of a certain beast was 36 inches, then the heights at the middle of the back, at the croup and at the root of the tail would in a good level animal practically be the same. The measurements would then work out as follows, and become very simple :—

a=36 inches.
b, c, d=36 „
e=39·6 „
f, g=12 „
h=18 „

OXEN. | Measurement of Cattle in Europe.

THE GERMAN SYSTEM.

Means of application.

The following is the method of procedure. The cows and bulls of two or three neighbouring villages are summoned to a meeting. Upon a chosen public place a square space of 15 to 20 yards is enclosed by a barrier. The public stand outside the barrier and are able to follow all the operations of the jury composed of a delegate from the Agricultural Society, a member appointed by the exhibitors, and a Veterinary-Surgeon who manipulates the measuring standard. The animal led by the owner is placed in the centre upon a level surface. When standing square, the Veterinary-Surgeon takes the measures and shouts them out in a loud voice so that the jury can write them down and the on-lookers can understand. Before commencing, the Veterinary-Surgeon explains the principle of the method. All animals not up to the average are excluded and the owners advised not to keep them for breeding. Those having the proper proportions are given rewards. These latter are divided into two categories ; B, animals having the necessary averages, A, those exceptionally good, for instance, if the measurement e is superior to measurement $a + \frac{1}{10}$ of a.

At the end all those in A class come back and other qualities taken into account such as fineness of skin, bone, etc., and a definite classification made. Other measures can be taken, length of head, shoulder, etc., etc.

Results obtained.

The author attended ten of these meetings in 1885 in different parts of the Duchy of Baden, and states that the on-lookers followed the method of procedure with much interest. Occasionally an owner might protest. If he did so, the Veterinary Surgeon patiently re-measured two or three times and asked the owner to rectify, if possible, the position of the animal. For these operations it is necessary for animals to be docile and quiet. This method, therefore, encourages gentleness on the part of the owners and improves the temperament of the animals.

One serious objection to this method of judging animals is that milking qualities are not taken into account. Measurements, however, are not made to produce good milkers, therefore the cattle are not always put in the front rank, but they are always put in Category A. For example, an exceptionally good milking cow classed exclusively on measurements had to be classed in the third rank but in Category A. It is well-known that milking qualities are an

THE GERMAN SYSTEM.

individual quality and have nothing to do with conformation. Still, as the author remarks, a good milker is an animal with a good digestion and a good doer, she ought, therefore, to be remarkable for a big frame.

Conformation.

As to be expected it was generally found that the pelvis of bulls was smaller than the pelvis of cows of the same breed. For the same reasons in adult cows the breadth of the pelvis was superior to the breadth of the chest.

Some opposition appears to have been encountered to this method, but little by little the advantages have become appreciated by breeders. In order to see if improvement is manifested, it is necessary in time to increase the standard and to alter the scale of the proportions. For instance, at first the minimum height of the chest from the ground of a certain breed was 6·6 per cent. of the height at the withers, it is now 5·2 per cent. ; the length of the sides and pelvis was formerly 33 per cent., it is now 36 per cent.

Improvement, how to be ascertained.

Good results attributed to the system.

It is stated that breeders have now altered their description of parts, as, instead of saying the head is too long, the shoulders too short, the pelvis too narrow, the chest too flat, they now say the head is more than 38 per cent. to the height of the withers, the shoulder is not 42 per cent., the pelvis is not 36 per cent., the length of the sides does not reach 50 per cent. of the height. Cattle have become long, large, near to the ground, straight-backed and the root of tail same height as withers, the coat has become finer and more silky and the bulk of bone diminished. Butcher's meat seems to have been improved. The meat and milk have improved in quality.

Adopted by German Society of Agriculture.

The Agricultural Society of Germany have ordered **Dr. Lydtin** and **Professor Werner** to make according to this system of measurement a survey of all the cattle of Germany and a large sum of money has been granted for the purpose. The work will appear in two years and every ten years a new edition will be published.

Application to French breeds.

The author argues that whatever be its destination, for labour, for milk, for meat, a beast should eat and digest its food well, therefore, it should have a large stomach and chest in the interior of which the heart and lungs can develop themselves easily.

He says **Dr. Lydtin** has indicated a scientific anatomical method of developing the chests and abdomens of exhibited animals. It has not been forgotten that above all in females the breadth of the pelvis is of great consideration. **Dr. Lydtin** has also shewn that the method is applicable to sheep.

System useful also for sheep.

OXEN. | **Measurement of Cattle in Europe.**

THE GERMAN SYSTEM. Application to French breeds (*continued.*)

For application it is necessary to recognize two ways—

(1) The actual German system which classes the animals at the meetings exclusively according to measurements of all parts of the body. This, it is remarked, is characterised by a German method of exactitude which would not be acceptable in France.

(2) The primitive method which relies upon the use of some chief measurements and allows a few years for the cattle to improve seriously. This method a little more minute should, it is said, be acceptable to the breeders of France. Up to the present animals have simply been judged in France at shows by experienced breeders, but this is not considered sufficient by the author. He thinks breeders would profit by a system of measurement and that their anatomical education would be improved.

The interested public should be shewn what animals it is necessary to preserve for breeding and what animals should be struck out and the reasons plainly put forward.

Value of breed manifested by good average animals.

The value of a breed does not consist of a reproduction of a number more or less considerable of a mediocre kind, but, on the contrary, a general production of animals of good average. Therefore instruction should be given and clever breeders would soon be able to pick out cattle which are capable of winning prizes at shows.

Selection.

Some figures, here given, were obtained at a meeting of working animals:—

Illustrative examples.

Munich, 1893. A level road 3 kilometres (1·864 miles), obstacles (heaps of sand) 30-50 centimetres high and 2 metres broad, weight moved 11,600 kilogrammes.

			Years old.	Living weight. Kilos.	Weight moved relative to Living weight. Per cent.
1.	Pair	Voigtland	5	1,274	910
2.	„	„	„	1,390	834
3.	„	Franconie	„	1,428	812
4.	„	Voigtland	„	1,530	755
5.	„	Chamau	4	1,551	744
6.	„	Miesbach	„	1,596	726
7.	„	Chamau	„	1,600	725
8.	„	Bayreuth	„	1,655	700
9.	„	Simmenthal badois	7	1,870	620
10.	„	Pinzgau	4	2,286	508

Measurement of Cattle in Europe. (*G. K. Walker.*)

OXEN.

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Illustrative examples (*continued.*)

At Donaueschingen, a pair of bullocks, 5 years old, put in motion 56 quintals weight over 50 kilometres.

At Magdebourg, a pair of bullocks, $5\frac{1}{2}$ years old, raised a weight of 45 quintals (in 38 minutes, 4 kilometres distance).

N.B.—1 Kilometre = 1,093·633 yards.
1 Kilogramme = 2·204 lbs.
1 Centimetre = ·39371 inches.
1 Quintal = 100 kilogrammes.

O. 551-94.

G. I. C. P. O.—No. 95 R. & A.—18-9-99.—2,225.—J. E. F.

(Vegetable Product Series, No. 50.)
(Dyes & Tans.)

THE AGRICULTURAL LEDGER.

1899—No. 9.

CÆSALPINIA DIGYNA.

(PODS.)

[*Dictionary of Economic Products, Vol. II.*, C. 26-29.]

TARI OR TERI PODS AS A TANNING AGENT.

A report on their analysis by PROFESSOR WYNDHAM R. DUNSTAN, M.A., F.R.S., *Director of the Scientific Department, Imperial Institute, London; with an introduction by* MR. D. HOOPER.

HISTORY.

The history of Teri pods, as traced in the records of the Agricultural and Horticultural Society of India, extends over a period of more than fifty years. Mr. A. Sconce, C.S., of Chittagong, in April, 1847, forwarded to the Secretary of the Society in Calcutta a basketful of the pods of a **Cæsalpinia** which grew wild in the district. The taste of the pods was noticed to approach the astringency of those of the Sumach, but the seeds were larger. Mr. Sconce wished to know whether the pods could be used like Sumach for tanning purposes, and requested a trial to be made. Mr. John Teil, of Kidderpore, undertook to test the properties of the new fruits, and the report which was afterwards communicated to the Society was most favourable. A skin was tanned exclusively with the pods, and the process of tanning extended over four days. Mr. Teil remarked, "The leather, I conceive to be of a very superior quality, possessing not only an equality in softness with that tanned with Divi-divi (**Cæsalpinia coriaria**) but surpassing it in colour and appearance, and is consequently capable of being used far more extensively for

Mr. Teil's experiments.

MR. TEIL'S EXPERIMENTS.

tanning purposes, especially when a bright colour is required, than the Divi-divi." After speaking further of its advantages, Mr. Teil recommended the cultivation of the plant not only at Chittagong but also in other parts of the country, and expressed his confidence that it would become an article of considerable demand in foreign markets besides being extensively used in India. The only objection pointed out was that the seeds were equal in weight to the tanning portion of the pods.

Wild in Chittagong.

Mr. Sconce replied to this report in July and expressed his satisfaction with the experiments. In response to the application for a further supply, Mr. Sconce stated that the hills about Chittagong were covered with the plant where it grew amid the ordinary jungle, but that the fruiting season was over. In the month of April the pods called *Jeree* or *Teree* could be procured in abundance.

Further experiments.

A further report on the tanning properties of the Teree of Chittagong was made by Mr. Teil in 1848, but the results were not so satisfactory as those arrived at before. The pods were not in such good condition, and it was surmised that they had been gathered before they were ripe, or that they were allowed to remain too long on the trees, or that they had become damp in transit.

Several hundred seedlings of the **Cæsalpinia** were raised in the Society's Gardens, and two maunds of the pods were distributed amongst a few of the chief tanners, dyers and merchants in London. It could readily be introduced all over Bengal.

Uses in medicine.

The shrub, according to the *Pharmacographia Indica*, is used in native practice. The root sold in the bazars as *Vákeri mul*, is astringent. It is given in phthisis and scrofulous affections in 6 massa doses mixed with milk, *ghí*, cummin and sugar. When sores are prevalent it is applied externally as well. Following the law of signatories, a kind of tuberous swelling which is found in the root is preferred for the latter ailment.

"Tourhi" pods.

The authors of the *Pharmacographia Indica* also refer in another place to an unidentified drug known as "Tourhi pods" in the following terms: "The dried pods, which are sold in the bazars of Bengal, are apparently those of a species of **Derris**; they vary much in size, being ½ to 2 inches in length, and from ¼ to ½ an inch in breadth. They are brittle and of a brown colour with a prominent dorsal suture." The authors remark on the astringency of the pods and state that

"TOURHI" PODS.

their principal use is in the preparation of writing ink. Medicinal properties are also attributed to them, since a decoction is sometimes used as an astringent injection in leucorrhœa, and in the form of a powder they are employed for cleaning and preserving the teeth and gums.

Composition.

From a preliminary analysis of Tourhi pods described in the above work (*Vol. I.*, p. 472), the seeds and pods together contain a large amount of tannin matter giving a blackish colour with ferric salts, and a resinous principle soluble in chloroform, and affording a yellow colouration with alkalies. No glucoside was detected. The moisture amounted to 4·73 per cent., and the ash, showing a trace of manganese, 2·86 per cent.

1892.

Mr. E. M. Holmes, Curator of the Museum of the Pharmaceutical Society, in acknowledging in 1892 some recent donations to the Museum, mentioned the receipt of a sample of *Tari* pods among a large number of Indian drugs which had recently been forwarded to London with the view of ascertaining if a demand would arise for them when better known in England. Mr. Holmes identified the pods as derived from **Acacia digyna.** Messrs. Gonne, Croft & Co. furnished an analysis of this consignment, from which it would appear that they contained 33¼ per cent. of tannin available for tanning purposes and suitable for making leather of a light colour. The tannin gave a blue-black colour with iron salts, so that the pods would serve also for the manufacture of ink.

Forwarded to London.

1893.

Inquiry instituted in India.

In 1893 the Officiating Reporter on Economic Products decided to include the pods of **Cæsalpinia digyna** among the commercial products to be collected and investigated in connection with the Imperial Institute during the year, and the Inspector General of Forests was requested to assist, through the medium of Forest Officers, in securing information and specimens. An extract from the appendix series to the "Indian Forester" for May 1893, based on a correspondence with a firm of tanners in Madras, served to stimulate the inquiry. The extract is taken from a note entitled "Tans of Southern India," and consists of a quotation from a letter from Messrs. Cammiade Brothers, Madras, to the Reporter on Economic Products, with reference to the possibility of obtaining a regular supply of certain tanning materials, including the pods of **C. digyna.** They write: "The pods of **Cæsalpinia digyna** are said to yield

INQUIRY IN INDIA.

leather as white as snow. If that report is correct, this tannin ought to cut out all others in Madras, provided it can be grown cheaply. Hence our desire to experiment with the pods, of which we have been promised a sample through friends in Madras."

In a communication to "Leather," Mr. Evans, Chemist of the Tanner's Laboratory, Bristol, says that "the pods of a plant from India, which must certainly have been brought to England before were sent to us as something new. They proved to be pods of

An expert's opinion.

Cæsalpinia digyna, and presuming they can be cultivated to any extent, the importers may be congratulated on their good fortune. They yield about 33 per cent. of tannic acid, which is in some measure like that of *babúl* **(Acacia arabica)** pods, which gives a cream-coloured precipitate; but this unites with gelatine in the form of a precipitate as white as driven snow, and its re-actions with other chemicals give divers colours, which will make it equally attractive to the dyer. In saying this much we can say with satisfaction as a chemist, that it is almost perfect; what may be its behaviour in the tannery remains to be proved."

Dr. MacCann in his "Dyes and Tans of Bengal," says that in Cuttack, the pods of what appears to be this plant are sold as a tan under the name of *Kunti*.

Furnished with these particulars, the circular issued from the Reporter's Office pointed out the desirability that more precise information should be obtained as to the habitat of the tree, its abundance, the proper season for collecting and available quantity of the pods, and the cost of collection and transit to the nearest centre for export. Specimens of pods, about 100 pounds from each locality, were asked for.

1894.

Specimens from Burma.

The Conservator of Forests, Eastern Circle, Upper Burma, was the first to respond. This officer sent from Mandalay in June 1894, samples of two kinds of pods, asking which, if either, was the fruit of **Cæsalpinia digyna.** The short pods with thick margins and constrictions between the seeds, obtained from a tree, were recognised as the fruits indented for; the thin leaf-like pods sent with them had been collected from a climbing, prickly shrub with yellow flowers, and these were identified as belonging to **C. sepiaria.** In July following the Conservator sent a bag of 39 pounds of the former pods, and these having been found to be authentic and in a good state of preservation, were registered under the number 4887.

Tari or Teri Pods as a Tanning Agent. *(D. Hooper.)* CÆSALPINIA digyna.

SPECIMENS FROM PEGU.

The enquiry for the pods was further prosecuted with success in Burma, and in compliance with the circular letter of the Inspector General of Forests, the Conservator of the Pegu Circle sent a bag of 68 pounds from Rangoon in April 1895. These were examined and given the registration number 6258. This consignment was accompanied by notes made by the Deputy Conservators of the three Divisions, Prome, Toungoo and Bassein, and the subdivision Myanaung.

1895.

Notes from Forest Officers.

These remarks are reproduced at length since they contain much original information regarding the material under discussion.

" *Prome.—Sun-let-the* **(C. digyna)** is a thorny scandent shrub growing on low ground and near streams in forest without bamboo and also with *thaik* and *myin* (in this Division). It flowers in February or March and the seeds are ripe in April the next year.

" About 1,000 viss* yearly could be gathered and delivered in Prome at R30 to R35 per 100 viss. The juice of the crushed leaves of this tree is used in cases of cataract in animals.

Toungoo.

" *Toungoo.*—As regards the occurrence of the tree in this Division, it is reported to be plentiful in suitable localities in the Zeyawadi Range, fairly abundant in the Bonmadi Range and scarce in the Thagaya Range; the tree is never found in country which is in the least hilly, nor in country which is swampy, its habitat *par excellence* is on level ground either near the banks of streams, or on waste land near villages, deserted village sites being favourite spots.

Pods ripen in March.

" The tree flowers in the cold weather, generally in December, and the pods are fit for collection at the end of February or in March.

" I can form no estimate of the quantity that could be collected as there has never been any demand for it, but there should be no difficulty in collecting 2,000 lbs. or so of the pods; and I should say that the cost of collection would come to about R5 per cwt. delivered at the nearest railway station.

Bassein.

" *Bassein.*—The fruit or pods are not, as far as I know, used much by the people of the country. The leaves are pressed and the juice used as medicine for the eyes of buffaloes and other animals. The seeds are sometimes roasted and eaten.

Myanaung.

" *Myanaung.*—Speaking generally, the leaves bear a very close resemblance to those of the tamarind tree, but the pods are much

* 1 viss = 3·65 lbs., Av.

NOTES BY BURMESE FOREST OFFICERS.

smaller. A pod contains two round seeds. The plant itself is seldom higher than 10 feet. It is a spreading scandent shrub and very spiny. The flowers appear about the middle of the rains and the pods ripen in February and March.

"The places in which *Sunlethe* is found are the high ground near kevins, along road sides bordering the foot of small hills, on the banks of some chaungs, in hedges near villages, etc. I have found it in laterite and sandy soils. It will never be found in ground that is saturated during the rains.

Uses of the seeds.

"As regards the uses of the plant: The pods when ripe are roasted, and the seeds* then eaten, principally by the younger portion of the population. If a large quantity be eaten in this way, it has an intoxicating effect. The root when pounded and mixed with water, is drunk as a febrifuge by some people, and has also an intoxicating effect."

No samples of teri pods have been received from Bengal. The Conservator of Forests sent fruits of *amul-kuch*, a vernacular name for **C. digyna**, with the hope of complying with the request of this office, but these on comparison with type specimens, proved to be the soapy fruits of **Acacia concinna, *var.* rugata.**

Specimens from Assam.

The collections of this product from Assam originated from independent inquiries in conjunction with **Mr. W. A. M. Duncan** and the Director of Land Records and Agriculture. **Mr. Duncan,** Assistant Commissioner, on special duty at Shillong, was engaged with the compilation of a "Monograph on Dyes and Dyeing in Assam," and on 6th May 1896, he forwarded the following letter to the Reporter on Economic Products :—

1896.

"Teri" in Sylhet.

"I have the honour to advise the despatch of a small packet containing specimens of a plant or tree known in Sylhet as 'teri.' It is used with sulphate of iron and the bark of **Terminalia**

* The occasional references to the use of these seeds for edible purposes is a matter of interest. The plant was named **Cæsalpinia oleosperma** by Dr. Roxburgh on account of the oil said to be present in the seeds. These statements caused me to undertake an analysis of them. The seeds were reduced to a powder, which was light buff-coloured, and extracted with ether. The ether separated from the starchy kernels 25·3 per cent. of a thick, light coloured oil. Sugar and albumen were present, and the air-dried seeds yielded 5·8 per cent. of water and 3·2 per cent. of ash. No reactions for tannin were observed in the various extracts.—(*D. H.*)

belerica and **Terminalia Chebula** (or **citrina**) to procure a fast ash-coloured dye. Could you kindly inform me whether it is the **Cæsalpinia Sappan** described at pages 10-11, Vol. II of the *Dictionary of Economic Products.*" The pods were identified as those of **C. digyna**; *Teri*, the Santali name for **C. Sappan**, having misled the correspondent. *Tári káyi*, or Tari fruit, is the Canarese name for the **Terminalia belerica**; *tari* or *teri* would thus appear in some districts to be referable to other tanning products than the pods here described.

SPECIMENS FROM ASSAM.

Owing to the large number of unknown substances mentioned in **Mr. Duncan's** useful monograph, the Reporter on Economic Products instituted an investigation into the botanical sources of these products, and the Director, Department of Land Records and Agriculture, Assam, cordially associated himself with the work of collecting the specimens. On the 24th March 1898, dried samples of the plant known as *teri* growing at Itakhola, Sylhet, were sent to the Reporter, and the Director was informed that they were those of **C. digyna.** The Director was also asked to furnish a substantial consignment of the pods for the purpose of having them tested with the Burmese samples. The application unfortunately arrived rather late in the season, and it was found possible to send only 11 seers of the pods. These were registered as 10795, and a portion was at once sent to the Imperial Institute for chemical analysis and determination of the tannin value.

1898.

The above few paragraphs give a concise history of the three samples of pods of **Cæsalpinia digyna,** analysed at the Imperial Institute and reported upon by **Professor Dunstan.**

The high percentage of tannin found in these pods is remarkable, since it equals, and in some cases exceeds the amount found in galls and other highly concentrated tanning materials both natural and artificial. It is only necessary to publish these results to create an interest in the subject, and with the interest no doubt will grow a demand for the *teri* pods of Assam and Burma.

High tannin value of teri pods.

Before giving **Professor Dunstan's** report it will be as well to insert a note on the pods of two other species of **Cæsalpinia** for purposes of comparison; these are Divi-divi **(C. coriaria),** and the Algarobilla of Chili **(C. brevifolia,** *Baill*).

CÆSALPINIA digyna. — Tari or Teri Pods as a Tanning Agent.

DIVI-DIVI.

C. coriaria, the pods of which afford the Divi-divi of commerce has for some time been experimentally cultivated in the Presidency of Bengal. Professor Dunstan has recently analysed three samples of these pods with the following results. The sample numbered 8028 from the Sonthal Parganas afforded 19·73 per cent. of tanning matter dried at 110°; sample 8027 28·80 per cent.; and sample 8028 from Rampurhat 32·79 per cent. These conclusions represent an average of 30 per cent. A fuller report on the cultivation and value of East Indian Divi-divi will appear in an early issue of the *Agricultural Ledger*.

Algarobilla.

Cæsalpinia brevifolia. Algarobilla. Mr. W. N. Evans (*Leather*, October 1887, 72) found that these pods contained a large amount of tannin, the fibrous portion yielding 11·02 per cent., and the gummy or resinous-looking portion 66·94 per cent. of this constituent. The seeds, however, form 22·86 per cent. of the weight of the pods. Mr. G. Zoelfell in 1891, found this tannin to be a mixture of two bodies, one of which (present to the extent of 8 to 10 per cent.) is the glucoside of gallic acid, and the other tannin present in much larger quantity has the formula $C_{14}H_{10}O_{10}$, which at 100° C., easily loses two molecules of water. The anhydrous acid, $C_{14}H_6O_8$, is called ellagic acid, and the hydrated acid (the formula of which is generally given as $C_{14}H_{10}O_{10}$) is called ellagenic acid (*Archiv. der Pharm.*, 1801, 123-160).

PROF. DUNSTAN'S REPORT.

Report on* Cæsalpinia digyna *pods by* PROFESSOR WYNDHAM R. DUNSTAN, M.A., F.R.S., *Director, Scientific Department, Imperial Institute.

Cæsalpinia digyna has been locally used in India as a tanning agent. The pods of this plant differ in shape from those of **C. coriaria**; they are much larger and hold two thick-shelled peas which contain oil but very little tanning matter. For use in tanning the pods of **C. coriaria** are ground entire, including the seeds, but since it was easy to remove the much larger seeds of **C. digyna,** the pod-case was ground alone, and by this means the portion containing the larger amount of tannin was separated. The pod-case is easily ground to a nearly white powder from which water readily dissolves the tanning constituents, furnishing a white liquid which is of a light or dark-brown colour, depending on its strength. The analysis of the powdered pod-cases shows a percentage of over 50 per

Fifty per cent. of tannin.

Tari or Teri Pods as a Tanning Agent. (*W. R. Dunstan.*) CÆSALPINIA digyna.

PROF. DUNSTAN'S REPORT.

cent. of tanning matter; in one instance (the sample from Assam) the percentage of tanning matter amounted to nearly 60 per cent. It is, therefore, clear that the tanning value of this material is greater than that of the South American Divi-divi, and it is, therefore, worth while to pursue the matter further and ascertain precisely what the commercial value of the pod-cases of this plant would be. In the case of Divi-divi, the usual plan is to prepare for the use of the tanner an 'extract' of the material, but the pod-cases of **C. digyna** are so rich in tannin that the material could be used direct by the tanner without the previous preparation of an extract, which, as is well known, is a disadvantageous process, since it always leads to a considerable enhancement in colour.

Pod-cases.

With the view of obtaining a practical opinion as to the tanning value of this powder, a sample was furnished to a well-known tanning expert, who reports that he is much impressed with the results that he has so far obtained, they compare very favourably with those furnished by the best Divi-divi, whilst the aqueous liquor from **C. digyna** did not appear to undergo the injurious fermentation which is the difficulty in the use of Divi-divi. He recommends that trial should now be made on a large scale in the tan-yard. For this purpose about a hundredweight of material would be required. If possible, the seeds should be separated in India from the pods, and the latter alone forwarded, preferably ground to a rather fine powder.

Tanning results favourable.

The followlng table includes the results of the analysis of three specimens of the powdered pod-cases of **C. digyna**, derived from Bombay,* Burma and Assam, respectively, the sample from Assam being richest in tannin:—

Cæsalpinia digyna.

Tables of Results

I. I. No.	Serial No.	Whence received.	Moisture per cent.	Tanning matter in material dried at 110° per cent.	Total soluble matter per cent.	Non-tanning matter per cent.	Ash per cent.
6921	6258	Pegu Circle, Bombay*, . . .	11·07	53·82	61·95	14·08	2·28
6372	4887	Eastern Circle, Burma . . .	10·93	53·86	62·83	14·86	3·76
9293	10795	Assam. . . .	11·40	59·89	65·80	12·73	1·84

* The samples were from Burma, not from Bombay.—[*Ed.*]

G. I. C. P. O.—No. 363 R. & A.—20-12-99.—2,280.—G. R.

(Vegetable Product Series, No. 51.)
(Dyes & Tans.)

THE AGRICULTURAL LEDGER.

1899—No. 10.

CÆSALPINIA CORIARIA.

(DIVI-DIVI.)

[*Dictionary of Economic Products, Vol. II.*, C. 19-25.]

DIVI-DIVI PODS.

A note on the cultivation of the plant in India, and the value of the pods as a tanning material, with a report by PROFESSOR WYNDHAM R. DUNSTAN, F.R.S., *Director of the Scientific Department, Imperial Institute, on three samples derived from Bengal.*

Introduction into India.

The introduction of Divi-divi into India was commenced in 1834. In that year **Dr. William Hamilton**, of Plymouth, issued a circular enumerating the virtues of the plant as a tanning material, and addressed it to chemists, dyers, tanners and others in different parts of the world. The circular set forth the use of the pods of **Cæsalpinia coriaria** in its home in South America, and described their successful introduction into Jamaica, and afterwards into England, among professional tanners. Experiments had been made in Bristol which showed that the tannin amounted to 51 per cent. of the pods, and the extractive matter exceeded that of nut-galls, sumach, kino, catechu and oak bark.

Dr. Wallich's efforts.

Dr. N. Wallich, of the Botanic Garden, Calcutta, on receiving a parcel of seeds from **Dr. Hamilton**, was able to raise a number of plants by December 1835, and they were reported to be thriving there remarkably well. Two years later flowers were produced and in 1840 ripe pods were furnished by the plants. Subsequently, in February 1845, **Dr. Wallich** wrote a paper on the subject of

CÆSALPINIA coriaria. **Divi-divi Pods.**

Introduction into India.

American Sumach or Divi-divi before the Agricultural and Horticultural Society of India. It was strongly recommended that the cultivation should be taken up in this country, not only on account of the richness of the pods in tanning matter, but also because of the facility of propagating the plant.

Method of planting.

The following suggestions were furnished for the guidance of intending cultivators. The seeds germinate in light garden mould mixed with sand. When the seedlings are about two inches high, they should be carefully placed in small pots, and when about three feet high they may be planted out in the open ground at least 12 feet apart. During the first hot season the plants may require a little irrigation in the very dry weather.

Calculated yield.

Dr. Hamilton recommended that the trees should be planted not closer than 18 feet apart; whence an English acre would contain 135 plants; and taking the average weight of produce from each tree when in full bearing at 100 pounds, the harvest would amount to 13,500 lbs. or about 6 tons of the Divi-divi pods.

Mr. Teil's experiments.

Dr. Wallich secured the co-operation of **Mr. John Teil** of the Kidderpore Tannery in making experiments with the cultivated pods. The results of the trials that were made left nothing to be desired. They were found to be equal to Aleppo galls in tanning fine skins, and a finer colour was produced. **Mr. Teil** considered that it was only necessary to cultivate the tree extensively in the country when it would become an important auxiliary to the *babul* barks both in tanning and dressing leather. **Mr. Teil** was awarded a gold medal by the Agricultural and Horticultural Society for his successful experiments and useful papers on the subject of this and other tanning products.

Dr. Stenhouse's valuation.

The pods grown in India were, in the year 1869, sent to London to be tested by **Dr. J. Stenhouse, F.R.S.**, Assayer to the Royal Mint. **Messrs. Smith, Fleming & Co.** wished the properties and chemical characteristics of the sample sent from this country to be compared with the Divi-divi imported into England from South America. The report of **Dr. Stenhouse** was communicated to the Government of Bombay by the Secretary of the Chamber of Commerce of that city.

The pods from Bombay were described as being paler in colour and considerably larger than the South American specimen. The

Valuation.

amount of tannin in the two samples was carefully determined by Shuler's process with gelatine and ammonium chloride, and found to be as follows:—South American 19·0 per cent., and Bombay 15·6 per cent. The verdict on this result, obtained by the use of a process which is now quite obsolete, is in favour of the American grown pods, although as Dr. Stenhouse remarked "The Bombay pods are larger and heavier, and the deficiency in tannin might be more than compensated by the increased weight of the Divi-divi the trees would yield."

Seeds widely distributed.

In the meantime the seeds of **Cæsalpinia coriaria** were distributed throughout India, and trial cultivation was attempted with more or less success in all the Government Experimental Farms, and in several private plantations. Notes on the cultivation have appeared in many agricultural reports, and correspondents to leading newspapers have occasionally given their experience in raising the plants.

The following notes taken from the chief communications available, will give a fair indication of the efforts made in this country to cultivate the Divi-divi pods for commercial purposes:—

MADRAS.

Madras.

Position in 1881.

This plant, up to 1881, was growing uncared for in many of the outlying villages of Madras, but when the pods were found to be a valuable article for tanning, large quantities were collected and shipped to Europe. A consignment of 88 bags was despatched to England by the *Duke of Buckingham* in that year. An acre of land containing 173 trees in full bearing was supposed to yield 50 cwt. of pods which were valued in London at £37 10*s*.

Report from Saidapet Farm.

In the Agricultural Report for Madras, 1882-83, it is stated that on the Saidapet farm at the beginning of the year there were 16 bushes, planted in 1879. They yielded 13 lbs. of pods at the end of March 1882, and again in March 1883 bore another crop of 60 lbs. of pods which yielded 4½ lbs. of seed. From the first crop a number of seedlings were raised and planted out in different places over the estate. There were thus 600 young seedlings ready for planting out to form an experimental plantation.

In 1883-84, it was reported that Divi-divi was planted out at distances of 15′ × 15′ in three acres of land. The total number of plants put out on the farm exclusive of those planted on the channel

MADRAS. Saidapet Farm.

banks was 521. They were thriving very well and were apparently hardy. Guinea grass was planted between the lines of Divi-divi in one of the plantations. Castor seed was sown between the lines elsewhere, but the crop was spoiled by the heavy rains and by inundation from the rivers.

"The 16 bushes of Divi-divi planted in 1879 in the Botanical Garden gave during the year 75 lbs. pods, 22 lbs. of the pods gave 2 lbs. seed."

In 1884-85 the dead plants destroyed by the heavy rains of the previous year were all replaced by fresh seedlings raised in the Botanical Gardens. The number of seedlings planted in blanks was 375. These were looking well and were occasionally watered. Some of the plants that remained out of those planted in 1883 had acquired a fine bushy growth, and reached from 4 to 5 feet in height. A few of them flowered during the year, but did not bear seeds.

In 1885-86 the Superintendent reported that a few pods were borne on the trees after the flowering period.

In the Annual Administration Reports of the Forest Department, Madras, the following extracts are of interest:—

North Arcot.

1890-91.—"Divi-divi does particularly well in North Arcot under the lofty shade of the Rain tree **(Pithecolobium Saman)**, but, in the open, looks yellow and stunted. About 2,000 pods were collected during the year and sown in a nursery; 1,350 plants have come up excellently."

South Kanara.

1893-94.—"In South Kanara some experiments are being made with Divi-divi and the two species of Mahogany; but success is indifferent and doubts are entertained as to the practical utility of continuing them until experimental gardens under proper supervision can be established."

Extensive cultivation feasible.

1894-95.—"Divi-divi—In North Arcot 312 trees succumbed out of 2,236 living at the beginning of the year. If a market could be found for the pods, no difficulty could be experienced in growing this upon a large scale.

"In South Arcot, of the 56 trees that remained at the beginning of the year, 9 died.

"There are 123 plants, 5 to 18 inches high, in South Kanara, which are being transplanted into the Wandse depôt."

1895-96.—"Divi-divi—The number of trees that survived at the end of the year in North Arcot amounted to 1,969. Half a ton of

pods was collected and sold for R23. There were 47 trees in the Nattangal tope, South Arcot, at the beginning of the year, to which 127 seedlings were added during the year. The 123 plants in the Wandse depôt, South Kanara, are living, but they are not looking well. They are now 3 years old and a few only are above 6 inches in height."

MADRAS.

South Arcot.

South Kanara.

1896-97.—"The collection of Divi-divi **(Cæsalpinia coriaria)** pods was the only departmental operation in Trichinopoly."

Trichinopoly.

1897-98.—"Divi-divi—In South Arcot the yield in Tindivanam has not been good, owing to insufficient rainfall. In South Kanara it has been a failure."

Bombay.

BOMBAY.

Mr. (now Sir) E. C. Buck writing on "Dyes and Tans of N.-W. Provinces," remarked that the tree had become quite naturalized in Western India.

The most interesting accounts of its cultivation in the Presidency are perhaps those of the Khandesh Experimental Farm Reports, 1881-82, from which the following extracts are reproduced: "The new crop of Divi-divi being a heavy one, a quantity of pods sufficient perhaps to make up a consignment for export will be available at the end of the rains. Most of last year's seed was distributed for sowing, which left on hand many hundredweights of broken pods for which no use could be found, as the *Chambhars*, both about here and in Poona, refused to have the article on any terms.

Khandesh Farm.

Attitude of Chambhars.

"A family from the Deccan was, therefore, encouraged to settle on the farm and work at their craft for daily wages. A few hides were spoiled at the outset, but good results are gradually being got at. In addition to the usual leathern articles of husbandry, some useful machinery belting has been made, a purpose for which ordinary village leather is usually unsuited, being too gelatinous and so liable to warp."

1882-83.—"The new crop from the old plantation of Divi-divi is a good one, and there is now a large quantity of pods on hand for disposal. Divi-divi seed was planted very extensively on the boundaries of the farm fields in 1881. The experiment, however, seems to have been a failure, as there is scarcely a plant to be seen."

Productive crops.

CÆSALPINIA coriaria. **Divi-divi Pods.**

BOMBAY.

Khandesh Farm.

1883-84.—"A good deal of the seed of this tree has, as usual, been distributed and a quantity sold to Ceylon seedsmen for retail sale. The experiment of tanning with these pods, the continuance of which was ordered by Government, was unfortunately interrupted last year from the Chambhar family who carried it on having returned to their home in the Deccan. Arrangements are now being made to fill up the vacancy.

Satisfactory trials.

"Belting prepared with Divi-divi still remains serviceable after three years' work on the farm. The results of trials made by local Chambhars with spare pods supplied to them are said to be in most cases satisfactory, but I have not yet examined the leather produced."

1884-85.—"The demand for seed of this tree continues about the same as last year. After some difficulty a suitable Chambhar was got for the tanning experiments, which are now making apparent progress; the actual measure of success, however, will have to be determined by wear or by the opinion of some one acquainted with the subject."

1885-86.—"As usual a large quantity of the seed of this tree has been supplied to applicants all over India and Ceylon. Experiments in tanning with the pods have also been continued, leading to the conclusion that the use of the articles in this country is wasteful, considering its high value in the European market; also that other suitable tanning materials are so plentiful in India and to be had for the mere gathering. About 3 tons of pods are lying ready packed for despatch to London on receipt of instructions."

Divided opinions.

Trial shipment.

1886-87.—"This year's produce, about 1 ton and 5 cwts., was at the desire of the Director of Agriculture, sold to Messrs. W. and A. Graham & Co., who intend making a sample shipment. The whole lot delivered ready packed at Pachora Station was purchased for R100 per ton. This with the consignment sent to London last year will, it is hoped, be the means of ready sale, every year, of this very useful tanning material."

1887-88.—"Divi-divi—This year's outturn was nearly 1 ton 8 cwts., of which 1 ton has been sold to Messrs. Graham & Co. at R60 per ton, the remaining pods having been broken up for gathering seeds for future sowing, as per Director of Land Records and Agriculture's order No. 2022, dated 30th November 1887. In pursuance of the same, some 100 Divi-divi seedlings are ready in pots. Arrange-

BOMBAY.

ments are also made to raise many other seedlings of the tree to meet requirements."

Khandesh Farm.

1888-89.—"The Divi-divi plantation, which has now become a regular source of income to the farm, was extended along the course of the *nála* marking the western boundary of the farm, and more seedlings are ready for a new plantation, which will be undertaken this monsoon."

Extension of plantations.

1889-90.—"There is no demand for Divi-divi in this country, a consignment of about 3¼ tons has been sent to England through Messrs. Graham & Co. An extension of the Divi-divi plantation over 5 acres failed on account of scarcity of water in hot weather."

Hopeful prospects.

Mr. E. C. Ozanne, Director, Land Records and Agriculture, Bombay, in his review on the above report, says: "I am glad to be able to report that the 5 acres of Divi-divi, which at the time of his report the Superintendent (of the Khandesh Experimental Farm) thought a failure on account of the drought, are promising, as all the seedlings have revived and show well."

1890-91.—"The Divi-divi has shown itself to be a very hardy plant."

In his review of the above report Mr. E. L. Cappel, Director, Land Records and Agriculture, Bombay, says: "The 3¼ tons of Divi-divi sent home realized R120 per ton. The experiment is too young, and the plantation too small to estimate the net profit on the cultivation of this product, but the experiment is being extended, and it certainly promises well. The difference in the farm accounts between cost of collection and transport and price received, amounts to R80 per ton, and this should leave a wide margin of profit under suitable conditions. The cost of planting is not heavy, though the trees are raised from transplanted seedlings; once established, the tree does well in poor soil and exhibits astonishing powers of resistance to drought. The tree, however, requires about ten years to arrive at maturity."

Plants mature in 10 years.

1891-92.—"Fruit trees, Divi-divi and *babul* plantations now occupy about 20 acres."

In his review Mr. E. L. Cappel, Director, Land Records and Agriculture, Bombay, on the above report says: "Additions will be made to the Divi-divi plantation near the homestead where water can be supplied without too heavy an expenditure."

CÆSALPINIA coriaria. — Divi-divi Pods.

BOMBAY.

Khandesh Farm.

1892-93.—" Fruit trees, Divi-divi and *babul* plantations occupy about 20 acres."

Annual Report of the Director, Land Records and Agriculture, Bombay.

1887-88.—" The cultivation of this tree is being extended in the Southern Division. The gatherings of last year's produce amounted to only 20 cwts."

Dharwar.

1888-89.—" With a view to ascertain the probable yearly outturn of the Dharwar Divi-divi plantations and to assess the price quoted for Bombay Divi-divi in the British markets, the right of collecting pods was farmed to Messrs. Chrystal & Co., of Hubli. The crop amounted to 69 cwts., which, together with that of the previous year (21 cwts.), has been shipped to London, and a part of it sold at 7*s.* 9*d.* per cwt. On the Bhadgaon Farm the Divi-divi plantation has been extended along the course of the *nála* marking the western boundary of the farm. The crop which amounted to about a ton and a half has not found a purchaser. The Kanara plantation now contains 19,703 trees. It is in good condition, and during the last season yielded 12 maunds of pods, of which 3 maunds have been sent to the Divisional Forest Officer, Dharwar.

Kanara Plantation.

Another profitable shipment.

1889-90.—" A test shipment of pods was made this year of about 3¾ tons, the produce of about 150 trees on the Bhadgaon Farm for two years. The trees are along a *nála* bank, but, if regularly planted out, would occupy about 3 acres. Picking the pods and filling the bags cost R22-8 ; bags, R28-2 ; railway charges, cartage, freight, R166-3 ; charges in Liverpool, R38-10 : total R255-7. The consignment sold for R409-11, or R111-4-6 per ton. The profit was R154-4. This is equivalent to R26 per acre per annum, which must be considered an excellent return. This result is encouraging to the extended cultivation of Divi-divi.

1890-91.—" The Bhadgaon Farm produce was sold locally for R90 ; this is an advance on the profit of last year, and there are good hopes of an industry being established as the trees grow and their value becomes known."

Bhadgaon Farm.

1891-92.—" Divi-divi—The Bhadgaon produce was not sold this year. That of the road-side trees in Dharwar fetched R20 at auction."

BOMBAY.

1892-93.—"Divi-divi—The growth of Divi-divi has not extended, and it does not seem necessary to refer again to this dye till results of interest have been secured."

Before concluding the remarks on the subject as affecting this Presidency, it will be useful to reproduce a summary of reports on Divi-divi cultivation in Bombay, drawn up for Government in 1888.

Summary of operations.

"With his despatch No. 3, dated 20th January 1887, the Secretary of State forwarded for such action as might be deemed advisable copy of a correspondence with the Lord-Provost of Glasgow and Messrs. Martin & Miller, Tanners of Glasgow, in which the latter suggested that if steps could be taken by this Government to extend the plantation of the Divi-divi tree, they would pledge themselves to take 8,000 tons of pods yearly at £7-10-0 to £8 per ton delivered in Glasgow.

Messrs. Martin and Miller's offer.

"2. In Government Resolution No. 1579, dated 15th March 1887, issued on this despatch, the Director of Land Records and Agriculture and the Conservators of Forests were asked to favour Government with their opinion and suggestions on the extension of Divi-divi cultivation. The following is a summary of the reports.

"3. The Director of Land Records and Agriculture (Mr. Baines) forwards, with his own remarks, reports on the subject by Mr. Stormont, Superintendent of the Bhadgaon Farm, and Mr. Ommanney, Acting Collector of Dhárwár. Mr. Stormont states that the rate of £8 per ton, offered by Messrs. Martin & Miller, would not cover the expense of collection and freight, and that the last consignment of similar quality was sold in open market at £15 per ton. The latter would, in his opinion, be a profitable rate and is not much higher than the average.

Value £15 per ton.

"4. In Mr. Ommanney's opinion there are two main obstacles to the spread of the tree : (1) the ignorance and apathy of the cultivating classes, and (2) the cattle which have the free run of the country and destroy the young plants. Mr. Ommanney states that the Divi-divi has been successfully cultivated in Dhárwár and that it would be possible for the Agricultural Department to conduct an experiment in gathering the pods on a considerable scale. The results of the experiment might be published in a suitable form and this would in his opinion go a great way towards overcoming the ignorance and apathy of the cultivators. Mr. Ommanney is in doubt whether it will

Mr. Ommanney's opinion.

BOMBAY.

Summary of operations.

pay the cultivators to grow the Divi-divi as it requires soil not inferior to that in which fair mango trees can be grown, and suggests that in that case the extension of its cultivation must be undertaken by Government. In Mr. Ommanney's opinion the tree cannot be grown in forests as it requires nursing and forests are not the place for nursery work, but it can be grown on road-sides and on the banks of irrigation canals. In any case the plantation will have to be protected by fences against the inroads of cattle, and considerable outlay, especially for tending and watering the trees, will be necessary before the trees come to bear fruit. Mr. Ommanney concludes his report by suggesting that if the Agricultural Department can give the assurance that the extension of Divi-divi cultivation will be profitable,

Government concessions.

'it might be possible to grant land rent-free for its cultivation on condition that the *rayat* should with the regular assessment repay the assessment remitted in future years beginning with the sixth year when the trees probably begin to bear a respectable crop.'

"5. The Director states that the only two places where the Divi-divi tree has been extensively grown in the Bombay Presidency are Dhárwár and Bhadgaon, and that in Bijápur also a good beginning has been made. As regards plantations he thinks 'the best mode of

Best grown in plots.

growth would be in plots, except where the road-sides are not immediately bordered by cultivated land.' The use of Divi-divi as a bank or boundary tree should, in his opinion, be deprecated. Mr. Baines is not aware if any successful experiments have been carried out in Gujarát or the Konkan, but states that in Dhárwár and probably in parts of Khándesh and Násik the Divi-divi can be grown without much trouble. As regards the method of realising a return from this tree, Mr. Baines thinks it will be necessary to adopt a plan similar to that in force with reference to the Myrobalan in the Southern Circle, and pay for each basket of produce delivered in good condition at designated centres. In Khándesh, this centre might be the Bhadgaon Farm, and for the Dhárwár District, Dhárwár, and as soon as the pods are in store, the sale might be notified and traders invited. The proceeds of the sale might at first be assigned towards extension of plantations. In conclusion, the Director expresses his opinion that commercially the encouragement of this tree will be extremely advantageous wherever water can be supplied at reasonable rates.

BOMBAY.

Summary of operations.

Sind Circle.

"6. The Conservator of Forests, Sind Circle, reports that two attempts have been made to cultivate Divi-divi in that Circle, and the results show that though the tree can be grown as a garden or road-side tree, it requires too much care to be grown as a forest tree to repay the expenditure necessary for its cultivation, and observes that there being practically no rainfall for the first three years, artificial irrigation is necessary and even with that the tree will only thrive in selected localities.

Southern Circle.

"7. The Conservator of Forests, S. C., reports that plantations on a very small scale have heen made above-ghâts in Kánara, Belgaum, Dhárwár and Bijápur, and below-ghâts in Honávar, Dápoli, Kumta, Ankola and Kárwár, and that the experiments made with the plant were more or less a failure or only very partially successful, except in Kánara and Bijápur, where the plantations have been a success. On the whole the Conservator is of opinion that the plant might be reared almost anywhere in well-selected spots above or below *ghâts*, but that the cost of plantations would be considerable. To ensure success it would, he thinks, be necessary to have large plantations and a special establishment to look after them. In any case a considerable outlay would be necessary, and the Conservator is inclined to think that it would pay better to spend the money on the protection of existing forests, which are mostly in a bad state. The Conservator suggests that should Government decide on making plantations of Divi-divi, the experiment should be made somewhere in the neighbourhood of Londe, on account of the cheap railway carriage available there for the removal of the pods, and because the rainfall there is about the same as that of Yellápur where the plant has succeeded best.

Special establishment needed.

Northern Circle.

"8. The Conservator of Forests, N. C., does not think that the cultivation of the Divi-divi will be profitable, save immediately on the seashore and upon irrigated lands. He mentions the places in his own Circle where the cultivation of the Divi-divi might be extended."

N.-W. P. & OUDH.

North-West Provinces and Oudh.

Lucknow.

The progress of Divi-divi cultivation in these Provinces may best be obtained from the annual Reports of the Horticultural Gardens, Lucknow. In 1883-84, the Superintendent writes :—

"The area of the exotic plantation has been increased by the addition of an acre. The object of the Divi-divi cultivation is to

CÆSALPINIA coriaria. Divi-divi Pods.

N.-W. P. & OUDH.

Utilising vacant ground.

ascertain what can be made by cultivating it in a regular way for the pods. The trees are placed 15 feet apart each way: this, of course, leaves a considerable amount of vacant ground while the trees are young, and to utilize this a crop of *urd* (**Phaseolus mungo,** *Linn.*, var. **radiatus**) was grown between the trees during the rains, from which a profit of nearly R17 was realized. After deducting the charges connected with sowing, reaping and cleaning the grain, and after paying the year's rent, a profit of R12-3-3 still remains.

"During the hot weather the experiment of growing pumpkins by sowing them in the *thalas* is being tried. The trees (Divi-divi) have to be watered, and it was thought there would be sufficient moisture to support both; and, if successful, the gourds would shade and keep the ground cool."

1884-85.—"The acre of Divi-divi has made good progress during the year, the plants being strong enough, it is thought, to do without water during the coming hot weather. The experiment of growing pumpkins in the *thalas* in the hot weather was not successful, but a good kharif crop of *urd* was gathered from the ground, giving a profit of R2-0-0 after deducting cost of watering, rent of land and all charges incurred in connection with the plot for the year. The advantage of this with regard to rearing this and trees of a similar kind requiring no comment."

Progress satisfactory.

1885-86.—"The experimental acre of Divi-divi continues to make satisfactory progress and the plants will soon cover the space left between them. No irrigation was given this year. One tree has died and two flowered and formed pods, but when examined they were found seedless. *Urd* was sown on the uncovered spaces, but a poor crop resulted chiefly on account of the heavy rains, which fell when it was growing. The gain on the crop was R3-2-0 only, which credited for rent, leaves a debit of R1-10-9 against the acre of Divi-divi for the year."

1886-87.—"The plantation of Divi-divi suffered greatly. Nearly the whole of the trees were killed down to within 2 or 2½ feet of the ground, which means that about 2 years' growth has been destroyed. Nearly all have thrown out free growth of young shoots, and the trees will no doubt ultimately recover."

1887-88.—"Though in a much better condition than last year, the experimental acre of Divi-divi is yet far from being in a satisfac-

tory state of growth. All the trees threw up a good young growth from the base, and where too numerous, these were thinned out. N.-W. P. & OUDH. Lucknow.

"About three-fifths of the trees have again had their leading growths killed back for about one-half their length, and the general appearance of the plantation is unthrifty."

1888-89.—"The Divi-divi continues to make slow growth and has not begun to bear pods yet." Growth slow.

1889-90.—"A few of the smallest Divi-divi trees were slightly injured by frost.

"The best trees in the plot are those forming the first line against the rain trees, from which it is inferred that shelter and partial shade are advantageous to the Divi-divi in this part of India.

"The greater portion of the trees are not at all promising. A few pods were gathered from one or two of the largest trees."

1890-91.—"The condition of the Divi-divi plot is much the same as last year; only three seers of very inferior pods have been collected from the whole." Condition of pods.

1893-94.—"In the plot of Divi-divi, two small trees have died, and the majority of the others lack vigour and make very little growth.

"A few of the best trees on the west side of the plot yielded a few pods; but only enough to supply our own requirements for seed."

1894-95.—"The acre plot of Divi-divi (**Cæsalpinia coriaria**) was greatly damaged by flood.

1896-97.—"It was decided to reduce the area planted with Divi-divi by the removal of all the stunted and sickly trees. The experiment is now confined to three rows of the best trees on the west side of the plot; they number 51, and all look healthy. It is quite clear that they thrive best with a certain amount of shade and shelter from tall trees such as the rain tree." Reduction of plantation.

Bengal. BENGAL.

The following notes on the extension of the American sumach in this Province are taken from the Annual Reports of the Department of Land Records and Agriculture :—

1887-88.—"The Government of Bombay called the attention of this Department to the cultivation of the Divi-divi tree (**Cæsalpinia coriaria**), from the pods of which an important agent in tanning is produced. Inquiries were made, and it was found that

CÆSALPINIA coriaria. — Divi-divi Pods.

BENGAL.

Kurseong.

Buxar.

some experimental sowings had been made in the Kurseong and Buxar Forest Divisions, but had failed. The Deputy Commissioner of the Santhal Parganás reports that some trees grown from seeds sown in 1882 near Doomka are doing well, and that the soil appears to suit them."

Santhal Parganas.

1888-89.—"The Deputy Commissioner, Santhal Parganás, reports that some trees planted in 1882 continue to thrive, and that he has now got a large stock of seedlings.

1889-90.—"The Deputy Commissioner, Santhal Parganás, reports that there are now about 360 Divi-divi trees in the compound of Katikund bungalow, and that they are thriving."

During the next five years favourable reports were issued by the Department. In 1894-95 five of the trees bore pods, five maunds of which were collected, and samples sent to the Reporter on Economic Products for valuation.

The Divisional Forest Officer of Chota Nagpur Division reported that 22 Divi-divi plants in the Palamau Sub-Divisional Office compound were alive at the close of the year 1889-90; in Hazaribagh 18 plants had survived and in Singhbhum the Divi-divi plants were doing well.

Failed at Kurseong.

In 1889-90 the cultivation in the Kurseong Subdivision was reported to have entirely failed.

1895-96.—"From the Report of the Deputy Conservator of Forests of the Santhal Parganás Division, it appears that, owing to the want of transplantation, the trees in the compound of the Katikund bungalow are not thriving so well as they otherwise might have done. It is proposed to sow fresh seed during the current year and to transplant the small plants subsequently. The pods obtained from the trees at Katikund were very few, and not of much use. At Jhilimili, one maund of pods was collected from one tree, which is to be used for seed purposes. At the Dumka bungalow, there are said to be five good specimens of the Divi-divi, the biggest of which covers an area of about 40 to 50 feet in diameter. Three maunds of pods were obtained from two of these trees."

1897-98.—"The Deputy Conservator of Forests of the Santhal Parganás Division reports that 35 trees at Katikund and 16 at Jhilimili are growing well. During the year, about two seers of seeds were sown in beds at Katikund, and of the 151 plants raised, one hundred are still living and doing well."

Divi-divi Pods. (*D. Hooper.*) **CÆSALPINIA coriaria.**

Burma.

BURMA.

In the Report of the Agricultural Society, Lower Burma, 1882, we learn that seeds of this plant, distributed by the Agricultural Department, germinated very freely in the Society's garden, and over a thousand plants were available for distribution at the commencement of the rainy season of 1883.

Mysore and Coorg.

MYSORE.

A few plants of **Cæsalpinia coriaria** planted at Fraserpet in Coorg in 1878, were useful as a shade for coffee. The trees are grown at Bangalore and a few provincial stations, but nowhere on a large scale. It makes slow progress at first, but when once started it is very tenacious of life and lives to an old age. These few trees fruit abundantly every year and, in the opinion of **Mr. J. Cameron**, this species will become remunerative in the forests.

DIVI-DIVI AS A TAN.

Divi-divi is classified by dyers and tanners as a true astringent, and is associated with oak-galls and myrobalans in yielding a maximum amount of tannin with a minimum amount of colouring matter. **Professor W. Crookes** alludes in the following terms to Divi-divi in his "Practical Handbook of Dyeing and Calico Printing."

Professor Crookes' opinion.

"Divi-divi, livi-divi, or libi-divi is now (1874) one of the most important astringents in the market. The pods are of different shades of brown, sometimes nearly black; they are about three inches long and one inch broad, and are usually warped, twisted, or even doubled up. The best pods are thick and fleshy and of a pale colour. Those which are dark, with black spots and blotches have probably been gathered in a damp state, or have been subsequently exposed to moisture, which greatly reduces their value. The amount of tannin in Divi-divi is greater than in sumach, or even myrobalans, but it is the first mentioned body accompanied by a peculiar colouring principle which limits the application of this ware. It is very largely used in producing a black upon the cotton warps of mixed goods. Divi-divi has another defect, it is of a glutinous or adhesive nature, whence fragments of the ground pods are apt to cling to the mordanted tissues, and when washed

Value as a tan.

away are found to have played the part of a resist, and protected certain portions of the goods from the action of the tannin. Consequently when the dyeing operations are completed the cloth appear speckled. Hence it is better to extract the ware with water, and allow only the clear liquor to come in contact with the goods. Divi-divi is generally the cheapest astringent."

Mr. Thorpe's opinion.

Leather, like other commodities of a marketable nature must be judged by certain standards such as colour and texture, and the lighter the shades, and closer the texture, the better is the hide. **Mr. E. G. Thorpe,** Podanur, writing to the *Madras Mail*, in September 1888, gives his experience of Divi-divi in these respects. He has noticed that it gives weight to leather, but the extractive matter imparts a reddish-brown colour to the material which in the finished state becomes excessively streaked. It also possesses the undesirable property of gallic fermentation to an extraordinary degree which is a source of loss and annoyance to the tanner. The fermentation takes place rapidly under an increase of temperature, even in the presence of antiseptics. From this, **Mr. Thorpe** concludes that the

Not suitable for India.

pods are not suited for India where more favourable materials are found. Leather tanned with Divi-divi also is influenced by the weather, having the peculiarity of being soft and pliant in the wet weather and firm in the dry season. It was only by using an antiferment that anything approaching successful results could be arrived at, otherwise an iridescent, oily appearance on the surface of the infusions indicated decomposition and foretold failure and loss. **Mr. Thorpe,** however, considers that this agent should find favour in Europe where climate and special appliances are favourable. Its advantages over other imported materials are, its comparative cheapness, richness in tannic acid, and excellent weight-giving property.

"Leather," article in.

In an article on Divi-divi in *Leather* for June 1887, it was stated that this article had remained almost stationary for twenty-five years, in the first place, because of the uncertainty of its arrivals and its erratic effect upon the quality and colour of the leather submitted to it. The same shipment has been known to impart a light and even colour to one pack of butts, whilst another pack under precisely the same conditions, has come out dark and spotted. Fermentation seriously effects divi and causes disastrous changes. A good plan to avoid these circumstances is to place the amount of powdered

pods in the middle of the leach so that air and light are excluded by the layer of top material. Another method is to boil the divi with liquor or water, add a little "anti-galline," and add the cooled liquor to leather in either pits or leaches which need it. About three boilings reduce the divi to pulp, and the exhaustion of tannin is complete, thus saving time and preventing fermentation.

"Leather," article in.

"A gummy substance in Divi-divi is absorbed by leather and adds to its weight, but this gum is not of so water-proofing a nature as the resinous matter which hemlock contains."

Professor Hummel in a report on tanning materials supplied to the Colonial and Indian Exhibition, says a sample of Divi-divi cultivated in India given him for analysis for tannic acid, contained 43·5 per cent.

Professor Hummel's report.

"It was pale-yellow, turbid, and had a money value as compared with other Divi-divi, of 11*s.* 9¼*d.* per cwt." He says, moreover, that if decoctions only were used then Divi-divi would be the cheapest and the best tannin matter to use; and Divi-divi extract is indeed used in moderate quantity. "As a rule, however, dyers and tanners prefer to make their own decoctions with the ground tannin-matter, introducing the textile fabric or skins into the muddy liquid. For this mode of working, the dark outer skin of the Divi-divi pod is objectionable since it attaches itself to the fabric and in minute particles, and causes spots or stains. My results accord entirely with those given in Crooke's "Handbook of Dyeing and Calico Printing."

Conf. p. 15.

Foreign Divi-divi.

The results of the analysis of Foreign Divi-divi showed that it contained 44·25 per cent. of tannic acid, was pale reddish coloured and turbid, and had a value in December, 1886, of 12*s.* per cwt., equal to 3·25*d.* per 1 per cent. of tannic acid per cwt.

Imperial Institute Inquiry.

Mr. W. H. Lovegrove, Deputy Conservator of Forests, Bengal, Santhal Parganás Division, wrote the following letter to the Reporter on Economic Products under date 3rd June 1896 :—

"I have tbe honour to inform you that I have about one maund of the pods of Divi-divi (Cæsalpinia coriaria) from which I have extracted the seeds and about a maund and half of pods from which the seeds have not been removed.

CÆSALPINIA coriaria. **Divi-divi Pods.**

Imperial Institute nquiry.

"As the trees appear to grow very well in this district, I am writing to ask you if you can help me in arranging for the disposal of the above so that I may obtain some information regarding its actual value and importance commercially for the future expansion of the growth of that tree.

"I know there are some tanneries in the North-West Provinces but I am not aware of the names of those who would be likely to help me in ascertaining whether it would be profitable to encourage the growing of the Divi-divi in this district."

Mr. Lovegrove was asked by the Reporter to send the entire stock of pods, when a promise was given to send it to the Imperial Institute for chemical examination and valuation by expert tanners.

On the 22nd July, 3 bags containing 1 maund 7 seers of pods (Reg. No. 8028) and 1 maund 8 seers of powder (Reg. No. 8027) for market value and chemical analysis. On the 30th July a further supply of 4 bags of the pods weighing 3 maunds were received from the Deputy Conservator. These were registered under number 8028 (2nd consignment).

The bulk of these samples were sent to the Imperial Institute in August to be handed over to the Research Department.

Professor Dunstan's Report.

Report by **Professor W. R. Dunstan, F.R.S.,** *Director of the Scientific Department of the Imperial Institute.*

On the Tanning Materials of India.

Part 2. The Cæsalpinias.

The present report deals with two varieties of **Cæsalpinia** indigenous to India. **C. coriaria** or Indian "Divi-divi" has already found considerable use as a tanning agent both in India and in Europe. **C. digyna** * has apparently so far been used as a tanning agent only in India, and even there to a very limited extent. As little or nothing is known as to the nature and amount of the tanning constituents of this species, it was thought desirable to submit it to examination.

The results obtained in the examination of these two species of **Cæsalpinia** show that whilst **C. coriaria,** Indian "Divi-divi," is in-

*The report on the pods of Cæsalpinia digyna will appear in a separate *Agricultural Ledger* which will deal exclusively with that species.—[*Ed.*]

ferior to the product derived from South America, and largely employed by the tanner, **C. digyna** seems likely to be a valuable tanning agent, possibly superior to the best "Divi-divi" of European commerce. In order to substantiate the value of this material indicated by the results of the present preliminary examination, it will be necessary to transmit a larger supply in order that tanning experiments may be conducted with some approximation to the conditions which obtain in the tannery.

Professor Dunstan's Report.

Pods of Cæsalpinia digyna probably superior.

(*I*) Cæsalpinia coriaria (*Indian Divi-divi*).

The Divi-divi of commerce which is obtained chiefly from South America, usually contains from 30 to 50 per cent. of tanning matter. Indian Divi-divi has so far been regarded by the tanner as inferior to the South American product. The result of the analyses now recorded confirm this conclusion; the two specimens derived from the Province of Bengal represent an average of about 30 per cent. of tanning matter. It is possible, however, that other samples collected in different districts and at different stages of growth might show better results, and it is possibly desirable to pursue the enquiry further in this direction, although it should be remembered that Divi-divi is at present regarded with some disfavour by the tanner, on account of the acidity of its aqueous extract and its liability to undergo fermentation, which leads to the production of red stains on the leather.

Bengal Divi-divi inferior to that of South America.

I. I. No.	Serial No.	Name.		Whence received.
7447	8028	Cæsalpinia coriaria.	Pods.	Santhal Parganás, Bengal.
7437	8027	„ „	Pods and seeds.	„ „
7438	8028	„ „	Pods.	Rampur Hât, Bengal.

Analyses.

I. I. No.	Serial No.	Moisture per cent.	Tanning matter in material dried at 110° "per cent."	Total soluble matter "per cent."	Non-tanning matter "per cent."	Ash "per cent."
7447	8028	12·80	19·73	57·48	40·0	3·19
7437	8027	11·30	28·80	55·68	30·06	2·37
7438	8028	13·10	32·79	40·0	28·5	3·30

G. I. C. P. O.—No. 474 R. & A.—3-1-1900.—2,230.—B. N. D.

(Forest Series, No. 4.)
Timbers.

THE

AGRICULTURAL LEDGER.

1899—No. 11.

XYLIA DOLABRIFORMIS.

(IRON-WOOD OF PEGU.)

[*Dictionary of Economic Products, Vol. VI.*, X. 16-20.]

THE IRON-WOOD TREE OF PEGU AND ARRAKAN.

A Revision of the article on that subject as given in the Dictionary of Economic Products, with special reference to the timber, and the employment of the refuse wood as a tanning material.

INTRODUCTORY.

The Reporter on Economic Products, with the concurrence of the Inspector General of Forests, took up in 1894-95, the collection of specimens of not only the timber but also all other useful products of **Xylia dolabriformis** so as to obtain complete information concerning the tree. A circular note (No. 24 of 1894-95) was drawn up and issued to all Forest Officers in districts where the tree is found, and utilising the knowledge already brought together in the *Dictionary of Economic Products*, the various officials were requested to verify the information and extend the enquiry wherever practicable, and give full replies supported with authentic specimens, on the subject of Habitat, Resin, Oil and Timber of the plant.

The response to the circular has resulted in the submission of some very valuable notes drawn up by the officers concerned, and this has made it possible to compile a revised article on the Iron-wood of Pegu more complete and interesting than anything previously published on the subject.

The following among others have obligingly contributed notes and specimens regarding **Xylia dolabriformis**:—

Madras.—Collector of Vizagapatam.

„ Forest Divisional Officer, Bhadrachellam, Godavary.
(Through E. D. M. Hooper, Esq., Acting Conservator, Forests, Northern Circle, Madras, dated 7th July 1895.)

„ G. Hadfield, Esq., District Forest Officer, South Malabar, dated Nilambar, 16th November 1895, 2nd note, 6th March 1896.

„ W. H. Welsh, Esq., Collector, South Canara, dated Mangalore, 23rd September 1895.

Bombay.—J. McGregor, Esq., Conservator of Forests, Southern Circle, dated Belgaum, 21st August 1895.

Central Provinces.—Conservator of Forests, Southern Circle, dated Chanda, 1st March 1895.

„ „ Forest Divisional Officer, Raipur, dated 19th March 1895.

Bengal.—Extra Assistant Conservator, Forests, Puri Division, dated Khurda, 21st February 1895.

Burma.—Assistant Conservator, Forests, South Tenasserim.
(Through Officiating Conservator, Tenasserim, dated 28th September 1895.)

„ H. Slade, Esq., Deputy Conservator, Forests,
(Through Officiating Conservator, Pegu Circle), dated Rangoon, 18th July 1895.

„ Deputy Conservator, Forests, Pyinmana Division,
(Through Conservator, Eastern Circle, dated Camp Kanni, 21st January 1895).

„ C. W. A. Bruce, Esq., Assistant Conservator, Forests, Upper Chindwin Division, dated Kindat, 6th June 1895.

„ Deputy Conservator, Forests, Lower Chindwin Division, dated Monywa, 4th May 1895.

Xylia dolabriformis, *Benth.; Fl. Br. Ind., II., 286; Ind. Kew. IV., 1240;* LEGUMINOSÆ.

THE IRON-WOOD TREE OF PEGU AND ARRAKAN.

Vernacular names and synonyms.

Syn.—MIMOSA XYLOCARPA, *Roxb.*; INGA XYLOCARPA, *DC.*; I. LIGNOSA, and DOLABRIFORMIS, *Grah.*

Vernacular.—*Jambu, jamba,* HIND.; *Boja, kongora, kangoda,* URIYA; *Jámbá, yenul, suria,* BOMB.; *Jámba, jámbha, suria,* MAR.; *Irúl,* TAM.; *Irúl, irúpúla,* MAL.; *Konda tangédu, tanjedu, tanjedu mánu, eruvalu, bójeh, bója,* TEL.; *Jambe, jambí, tirwa, tirawa, shilve,* KAN.; *Pyin, pyinkado,* BURM.

Habitat.

Habitat.—A large deciduous tree met with in the Central Provinces, South India and Burma. To more particularly describe the regions where **Xylia** flourishes, the reports of Forest officers will be utilised.

Madras.

Madras.—The tree occurs most abundantly all along the hill slopes of the Vizagapatam district, but scattered trees may be met with at the foot and top of the Ghâts. These hills are the outer ranges on the Eastern Ghâts and lie 65 miles from the sea coast. In the Godavari district the tree is found chiefly in the hills between the Bhadrachellum and Rampa taluqs. The scattered trees on the plains are generally stunted. It is distributed throughout Malabar, but at Nilambur and Palghat it tends to form pure forests. In the South Kanara district, the zone intermediate between the Ghât region proper and the westernmost forests of the terai may be considered to be its true habitat, as it flourishes most abundantly there. Ascending the Ghâts, the tree gradually disappears, and is almost absent on the plateau of Mysore.

Godavari.

Malabar.

South Kanara.

Travancore.

It is not found to any appreciable extent in the Madras "Central Circle." In Travancore it does not occur south of Shencotta, but is abundant and grows to a large size in North Travancore.

Bombay.

Bombay.—It is common throughout the Southern Circle, south and west of Belgaum. It is commonest in the Khanapur range of Belgaum and the northern division of Kanara. In the Khanapur range the tree occurs almost entirely as coppice, which is used as railway fuel, with a revolution of the tree of 30 years. In the northern division of Kanara in the Supa and Hallial ranges, large timber of this species is found in considerable quantities. It is not easy to define the present area affected by this tree. The area of the Kanara forests is about 3,500 square miles, and *jámbá* occurs in

North Kanara.

XYLIA dolabriformis. **The Iron-wood Tree**

Habitat.

masses sporadically nearly all over the area. It is rare in the Central Circle.

Central Provinces.

Central Provinces.—In the Central Provinces it is found scattered in all the forest areas of the Chanda division, south of a line from Chanda, Mohali and Chamorsi. In the Raipur district it is only met with occasionally, but at Balaghát it occurs in abundance and forms, in places, a gregarious growth, especially in the Bhanpur, Kinhi and Chouria Zamindaris. Generally it may be said to occur in the Southern and South-Eastern districts, but in the Northern Circle the species is permanently dwarfed and occurs only sparingly, and in some of the warmer, dry valleys, in the form of low shrubs.

Bengal.

Bengal.—In the Puri division it is only found in zillah and Dandunal (*i.e.* North-East portion) bordering Dampara Estate in Cuttack district, about 27 square miles in Chundka, Borapita, and Turka reserved forests, and 10 square miles in the protected forests of Bhundarakhua, Kadamhur, Dantarekha, Kaduamoondia, Sarquna and Kangoragir Hills.

Assam.

Assam.—This tree is not known in this province.

Burma.

Burma.—**Xylia** is comparatively scarce in Mergui, South Tenasserim, and the southern portion of Tavoy, but north of Siam Road it is plentiful, though often inaccessible. It is most accessible in the following forests :—

Kalemaung Reserve.	Nalkyizin Forest.
Kyanshat Forest.	Heinze „

It is plentiful in the forests south of Sinthé, and is also found in the moister forests in the Yamethin sub-division, east of the railway. Very abundant on the western slopes of the Pegu Yomas, and extending down to the plains.

In the Upper Chindwin Forest division it is common on the left bank of the Chindwin, south of Kindat, down to the borders of the Division, on the right bank of the Chindwin southwards from the Sitthaung-Tamu road to the end of the division, and east of the Ayu River. It is easily accessible and very plentiful in most places, except perhaps in the Kubaw valley, where it is scarce.

Season of flowering and fruiting.

PERIOD OF FLOWERING AND FRUITING.

Xylia dolabriformis is a deciduous tree and sheds its leaves at the close of the cold season. The tree flowers in Madras and

Central Provinces at the commencement of the cold weather, in November and December; in Bengal this takes place earlier, in September and October, while in Burma the flowers uniformly appear in March. In January and February when the old leaves have fallen and the new flush of a bright pink colour replaces it giving the tree a handsome appearance, the pods from the previous year's flowering begin to form and develope. If trees are felled in Burma in December or January green pods are found on them which from their colour are scarcely distinguishable from the leaves unless examined closely. The fruits thus remain on the tree till the following year's flowers appear. As the hot weather advances, the thick, woody pods ripen, and while remaining on the tree, or at the time of falling, dehisce and scatter the seeds in all directions. In Malabar, the pods burst on the tree, and the seeds begin to drop from the end of January and continue to the end of March, when the new leaves begin to appear.

Season of flowering and fruiting.

Throughout the whole of Burma, and in South Kanara, the period of collecting the seed is during the months of March and April.

SOIL AND CLIMATE.

Soil and Climate.

Madras.—Xylia **dolabriformis** affects moist localities, and thrives best on hill sides with a northern or north-western aspect. In the Godavari it grows to a large size on the hill slopes where the rock is greatly disintegrated, and in shallow dells where the soil is deep. It has not been noticed to affect any particular aspect. The Rikapalli Hills where it grows are supposed to consist of metamorphic sandstone. In South Kanara the tree apparently prefers a gneiss to a laterite soil, and on such tends to form pure forests. It does not occur on sandy hills. As regards climate the tree prefers a heavy rainfall of not less than 100 inches, a moist, warm atmosphere, and low altitudes up to 1,500 feet. In Malabar it thrives in sandy loam three to six feet deep with a laterite subsoil; the land must be well drained but fairly moist. The rainfall here is 100 inches, mostly falling between 15th June and the end of October. It grows in Travancore in open grass land and also in moist forests, but does not ascend the hills to any height.

Madras.

Bombay.—*Jámbú* is found only in the moist parts of the Southern Circle. It does not occur east of a line drawn from Belgaum to Dharwar, and seems to require a rainfall of at least 40

Bombay.

Soil and Climate.

inches for its natural growth. It is found chiefly on laterite which seems to afford the soil (a sandy clay) best suited to its growth.

Central Provinces.

Central Provinces.—It is reported that sandy loams on dry hillsides is the usual character of the forest land. In a dry climate it has a diminutive growth, but occurs in abundance, while in clayey soil the tree assumes larger dimensions, but it is not found in any quantity. In the Raipur division it is chiefly found on plateaux where the soil is rocky and well-drained.

Bengal.

Bengal.—About Puri it is generally seen on stony soil and on slopes of low hills. It appears to thrive in a hot climate.

Burma.

Burma.—Commencing with the Tenasserim Division it is stated that Pyinkado requires a deep soil with abundance of water, and the largest trees are consequently generally found along the banks of streams. In the Pegu Circle it frequents either clay or loam.

It is seen to greatest advantage in the Upper Chindwin Division on drained soil, near streams, the ground being apparently free from humus. It dies out in moist or badly drained areas. It is never found in evergreen jungle. In Lower Chindwin it grows in rich soil. In contrast to the last statement the Divisional Forest Officer, Pyinmana, reports that *Pyinkado* is good everywhere where the soil is not too rich.

Congeners of Xylia.

TREES WITH WHICH* Xylia *IS ASSOCIATED.

Burma.

Burma.—In Upper Chindwin the finest occurs in teak jungle with **Cephalostachyum pergracile,** *Mun.*, as the bamboo undergrowth. The trees usually found with it are Teak, *Tauk-kyan* (**Terminalia tomentosa**), *Thitya* (**Shorea obtusa,** *Wall.*) and **C. pergracile.** It is also found among the moister kinds of Endaing. In Pyinmana it is associated with teak and an undergrowth of *Kyakaungiba* (**Bambusa polymorpha,** *Munro*). In Forests of the Pegu Circle Pyinkado is naturally found with *Taukkyan* (**Terminalia alata**), *Thinwin* (**Millettia pendula,** *Bth.*) *Thitpagan,* (**Dipterocarpus sp.**) it is generally found in company with—

Myauk kyaw (**Homalium tomentosum,** *Bth.*)
Zinbyun (**Dillenia pentagyna,** *Roxb.*)
Pyinma (**Lagerstrœmia Flos-reginæ,** *Retz.*)
Tauksha (**Vitex glabrata,** *Br.*)
Kabua or *Bambwe* (**Careya arborea,** *Roxb.*)
Pazimgo (?)

Congeners of Xylia.

Teak, with which *Pyinkado* often occurs elsewhere, is not found in this division.

Madras.

The most common trees with which it is associated in Vizagapatam, Madras, are *Nallamaddi* (**Terminalia tomentosa**), *Yegisi* (**Pterocarpus Marsupium**), Satin-wood (**Chloroxylon Swietenia**). *Nallamaddi* and *Yegisi* predominate, but though the area over which *Konda tangedu* abounds has never been surveyed or thoroughly inspected, it is known to be fairly abundant, and any reasonable demand, should such arise, could easily be met.

The Godavari offers a similarly constituted area, since the tree is not purely gregarious though large patches are to be found in which **Xylia** predominates. Frequently, mixed with it are found *Nallamaddi* (**Terminalia tomentosa**), *Siriman* (**Anogeissus latifolia**, *Wall.*) and *Yegisi* (**Pterocarpus Marsupium**).

In South Kanara it is generally associated with Benteak (**Lagerstrœmia lanceolata**, *syn.* **microcarpa**), **Terminalia paniculata** and **T. tomentosa**. **Schleichera trijuga** is also found with it but not to such an extent as the others. In Malabar similar conditions exist, as it is found with **Terminalia tomentosa, T. paniculata,** and one or more species of bamboo.

Bombay.

Bombay.—The names of the congeners of **Xylia dolabriformis** in the Southern Circle, Bombay, are perhaps **Lagerstrœmia lanceolata**, *syn.* **microcarpa**, *Wight*, **Terminalia tomentosa**, *Bedd.*, **T. paniculata**, *Roth.*, and **Phyllanthus Emblica**, *Linn.* It generally forms the principal species in the groups in which it occurs, as it is very shade-enduring, easily regenerates itself by seed and forms a good canopy. In a two-acre coppice plot it was estimated that the number of *jámbá* was 778, of **Lagerstrœmia** 179, of **Terminalia paniculata** 94, of **Phyllanthus** 27, of **Terminalia tomentosa** 7. The age of the dominant trees was about 45 years, and the number of trees on the plot was 1,174; and *jámbá* constituted 65 per cent. of the crop. In another enumeration of *seedling* forest *jámbá* averaged 40 per cent., **Terminalia paniculata** 25, and **Lagerstrœmia** 10 per cent. of the hardwood crop. In another its percentage was only 20.

Central Provinces.

Central Provinces.—In the Southern Circle, Central Provinces, the following trees grow in the forests with **Xylia**, viz.—*Gurari* (**Albizzia procera**, *Bth.*), *Saj* (**Terminalia tomentosa**),

Congeners of Xylia.

tendu, (**Diospyros**), **Kydia calycina,** and bamboo (**Dendrocalamus strictus**). In the Raipur Division the associates are *lendia* (**Lagerstrœmia**), *tendu* (**Diospyros**), and *dhoora* (**Chloroxylon**).

Bengal.—In Puri, Bengal, the tree allies itself with the following: *Bahera* (**Terminalia belerica,** *Roxb.*), *Sidha* (**Lagerstrœmia parviflora,** *Roxb.*), *Kumbhi* (**Careya arborea,** *Roxb.*), *Mai* (**Odina Wodier,** *Roxb.*)

Dimensions.

THE HEIGHT IT ATTAINS AND DIAMETER OF THE STEM.

Madras.

Madras.—A fully grown **Xylia** attains, in the forests of the Northern Circle, a height of 60 feet and a diameter of 2 feet, but the number of years it is supposed to grow before attaining these dimensions has never been ascertained. In favourable spots in the Godavari it reaches a height of 80 feet and a mean diameter of nearly 2 feet, but the greater portion of these trees are crooked and stunted. In Malabar the height is 40 to 50 feet, with a bole of about 30 feet, and a girth of 6 feet; it is supposed to reach maturity in 60 or 80 years. Reports from South Kanara show the height to vary from 30 to 60 feet, and the diameter from 18 to 24 inches. Probably 80 to 120 years are required for the tree to reach a diameter of 2 feet.

Bombay.

Bombay.—The tree grows to a very considerable age and trees 200 to 300 years of age are met with in Kanara with a diameter of over 3 feet at breast-height. But the commercially-exploitable age of the species is much lower, and trees that have reached a diameter of 24 inches at breast-height, and in some places 20 inches, are considered ripe for cutting. A tree 24 inches in diameter at breast-height would under favourable conditions be 80 to 100 years of age, with a height to its outermost branches of 80 feet, with cubic contents of squared timber of 50 cubic feet, and a current diameter increment of 0·1 inch. Under unfavourable conditions a tree of the same dimensions would perhaps be 120 years of age with a current increment of only 0·05.

Central Provinces.

Central Provinces.—The largest trees in the Central Provinces measure from 40 to 45 feet high and 4½ feet in girth. The age of trees of such dimensions is not known. In the Raipur Division the mature trees attain a dimension of 6 or 7 feet in girth and a trunk of about 30 feet high, and it is surmised that it takes 50 or 60 years to reach these limits.

Dimensions. Bengal.

Bengal.—In the Puri Forest Division in Bengal several trees were measured and the largest was found to be 25 feet to the first branch and 60 to the top, and 36 inches in girth or 12 inches in diameter at the thick end. The growth before reaching these proportions was supposed to be 40 years.

Burma.

Burma.—It does not grow so large in South Tenasserim as further north. The greatest girth attained locally is 9 to 10 feet, but even this is most exceptional, as heart-rot usually sets in soon after six feet is passed. A tree of such girth would probably be 150 to 200 years old.

The usual girth of *Pyinkado* in Pegu is 8 to 9 feet, but larger trees are occasionally met with. The height may be from 120 to 130 feet. In Pyinmana Division the dimensions of the larger trees are given at 120 feet in height and 6 feet in diameter, and the period in attaining such a size is recorded as 250 years. In Upper Chindwin good sized trees are from 45 to 65 feet high, some taller, and the girth of fine specimens is from 8 to 10 feet. The number of years it takes to reach this size is unknown, and it is probable that where these figures are given they are only to be regarded in most cases as approximate guesses.

PROPAGATION.

Propagation. Burma.

Artificial propagation of *Pyinkado* has not yet been attempted in South Tenasserim and Pegu. It reproduces itself freely inside reserves and all over the Pyinmana sub-division in suitable localities.

The tree propagates itself very naturally and freely and coppices very well in Malabar, but there has been so far no occasion to reproduce it artificially.

Bombay.

In Bombay, *jámbá* is most easily propagated by the system of natural regeneration of all the trees in the forest, and its cultivation has been found to be most easily extended in this manner. The seedling grows well in either thick or open covert.

Tables showing the rate of growth of *jámbá* coppice will be found in an appendix to the Administration Report of the Southern Circle for 1893-94. The mean growth in diameter at breast-height, for a tree 30 years old, was found to be about ·233 inch with a height growth of 1·33 feet annually.

XYLIA dolabriformis. — The Iron-wood Tree

Propagation.

No experiments have been made to propagate it in the Central Provinces, but should occasion arise the Conservator of Forests, Southern Circle, recommends the use of seeds, while the Divisional Officer of Raipur, from his observations, suggests coppicing.

Bengal.

The method by which it is most readily propagated in the Puri Division is by annual improvement thinnings in Chundka reserved blocks. It has also been tried by sowing seed. In 1886-87 a very small area was sown with seed in Chandmary Plantation. Recently several trees there have been measured and the largest was 22 feet high and 17 inches in girth at the ground level after 8 years' growth.

There is no doubt that natural re-production by seed is the best means of propagating **Xylia**, and the reasons in favour of this method are well summarised in the following interesting remarks made by the Conservator of Forests, South Kanara :—

South Kanara.

"Taking an area where it occurs with its associates, to judge of the facility of each for germination, it is found that the trees of this species have more seedlings under the parent trees than the others. Thus the best and cheapest way to propagate it would be broad-cast sowing. The seed has an advantage over those of the associated trees in falling on the ground later in the season when fires have almost ceased. Should, however, fires cross the forest when the seed has fallen, its hard testa is more able to withstand them, and after the monsoon has burst, the seed being heavy and flat has fewer chances of being washed away by the rain."

The Exudation.

EXUDATION.

A specimen of wood brought by **Dr. Wallich** from Tavoy in 1828 was so full of a red resin that it could be scraped off. The substance was partially soluble in hot water to which it imparted a reddish colour. The presence of this resin seems to be peculiar to the timber found in Burma, since the enquiry for this product of the trees all over India has produced only negative results.

The Koyas and hill Reddies of the Eastern Ghâts can give no information on the matter of the resin.

Similar to Kino.

This product is probably of the nature of kino, as it exudes in the hot weather in consequence of wounds made in the bark of the tree. It is produced in insignificant quantities in Burma, sometimes as the

Exudation.

result of an accident, and is not collected for the purposes of sale or use. The natives in South Tenasserim call it *Thitsi*, which simply means wood oil, and is the name generally applied to the oil obtained from the *In* (**Dipterocarpus tuberculatus**).

Not frequented by the lac insect.

The tree is not known to be used for supporting the lac insect. The only information that could be gathered on this subject was a remark from the Conservator of Forests, Southern Circle, Central Provinces, to the effect that the young succulent branches were in certain places attacked by the insect.

SEEDS AND OIL.

Oil.

The circular issued to all Forest officers particularly asked for information about the seeds and oil of the tree. Absolutely nothing was known about the oil, except from analogy derived from the fact that all seeds contain a fatty matter of some sort. To determine the proportion and nature of the oil present in the seeds, an analysis was made in the Economic Laboratory of a sample received from the Chindwin Division.

Amount of oil.

The seeds were reduced to powder and extracted with ether. The solvent removed 19·4 per cent. of a light coloured, transparent, fixed oil, with no unpleasant odour or taste. The powder was very palatable and contained considerable amounts of saccharine and albuminous substances. The moisture was estimated at 7·45 per cent., and the mineral matter 5·35 per cent. The percentage of oil is, however, too low to enable it to compete with those already in the market. The seeds also are hard and difficult to powder.

Seeds as a food stuff.

The seeds are eaten by the hill tribes of the Godavari as a dainty. The Gonds of the Central Provinces consume the kernel of the seed in large quantities after roasting it.

Collection.

The seeds are rather difficult to collect, as the thick pods discharge their seeds before they fall from the tree; they would thus have to be gathered before the seeds are shed. In the Central Provinces it is said that each tree yields from 4 to 6 seers, and in South Kanara half a pound, but the weight of seed is uncertain. A supply of seeds (11½ lbs.) received from Lower Chindwin occupied three men about a week, collecting over different localities. The pods although bulky contained only 6 or 7 small seeds in each. The cost of collection was calculated to be heavy, *viz.*, 8 annas to 12 annas per pound.

XYLIA dolabriformis. — The Iron-wood Tree

Properties.

PROPERTIES OF THE TIMBER.

The wood is hard, resinous and dark coloured and is highly appreciated in localities where it is to be had in fair abundance. "Neither the **Teredo** nor **Termites** will touch the heartwood." (*Sir J. Hooker.*)

It is known as iron-wood because of its weight (60 to 86 lbs. a cubic foot). "A rifle shot at 20 yards distance will scarcely cause any penetration into it" (*Colonel Blake*).

In confirmation of the weights quoted by various authorities, the following additional estimations have been forwarded in recent reports:—

58 lbs. (seasoned)	Travancore.
70 „ (unseasoned)	„
72 „	Malabar, Madras.
66 to 70 lbs.	South Kanara, Madras.
58 to 60 „	S. Circle, C. P.
67 lbs.	„ Bombay.
84½ „ (green)	„ „
55 „	Puri Division, Bengal.
76 „	Upper Chindwin, Burma.
81 „ (green)	„ „ „
52 to 79 lbs.	Lower Chindwin, „
68 lbs. (dead trees)	Pyinmana Division, „
79⅓ „ (green)	„ „ „
66 „ (sp. gr. 1·06)	Pegu Circle, Burma.
79 „ (sp. gr. 1·27)	„ „ „

Breaking weight.

"The breaking weight of a rod one square inch in section and 30 inches long, compared with other timbers of exceptional strength is—

	lbs.
Pyinkado	318
Teak	228
Kari	216
Oak	209
Jara	171

Crushing strain.

"The crushing strain per square inch it is capable of resisting compares with the same timbers as follows:—

	Tons.
Pyinkado	5·208
Teak	2·838
Kari	5·140
Oak	3·411
Jara	3·198

VALUE AND YIELD.

Value of timber.

No information concerning the market value of the timber can be obtained from the Northern Circle, Madras. The tree grows in inaccessible and unhealthy tracts and, being hard and close grained and not easily worked, has never secured a demand proportionate to its value. *Babul, nalla-maddi and yegisi* are found nearer at hand and answer fully the requirements of the ryots for door posts and agricultural implements. A log 7 feet by 10 inches diameter is a sample average stem of the trees found in the Agency Hill tracts of the Golconda Range.

Madras.

From the Government Forests, Malabar, which are of small extent, 1,000 cubic feet per year might be exported, but from private forests 40,000 cubic feet is annually exported. The sizes are from 14 to 24 feet in length, and 12 to 18 inches in quarter girth. The timber could be delivered at Olavacode Station, Madras Railway, at R20 per ton.

Malabar.

In South Kanara the value of the timber is placed at R50 per 100 lbs. The cost of delivering the logs on the Mangalore Bunder varies from R25 to R40, according to the distance of the place of extraction from the coast. Some could be put on board ship at R26 per ton. It is impossible to say how much timber may be extracted a year, as it is not known what establishment will be sanctioned by the Director, and suitable contractors are not at present obtainable, otherwise a large demand could be met from the district alone as regards more quantity, but owing to "heart-shake" the present quality of the wood is not good. In blocks suitable for wood pavement, 5,000 tons a year could be put on board at R32 per ton. The logs are of an average 25 cubic feet each.

South Kanara.

The cost per ton of 50 cubic feet, delivered at the nearest railway stations, would be about R24 on an average.

The price of a sleeper $6' \times 8'' \times 4\frac{1}{2}''$ delivered at stations on the line is R2.

Bombay.—It is not known what quantity of squared timber could be obtained annually, as only a small portion (which, however, is the best) of the *jámbú* area has been organised, but 10,000 tons may safely be assumed to be annually exploitable in Kanara, and 10,000 tons (of 68 cubic feet stack measurement) of railway fuel is certainly exploited annually in Belgaum, and probably much more over nearly the whole area. In 1888, 117,400 acres of forest in the Northern Division

Bombay.

Value and Yield.

of Kanara were examined with a view to the determination of the sustained yield of *jámbá*, and this was estimated to be 5,468 tons of 50 cubic feet each of squared timber. In the Khanapur range of the Belgaum Division, the mixed forest which produces the fuel of the railway, has a sustained yield of 45,000 tons (68 cubic feet each, stack-measured), and probably at least a quarter of this is *jámbá* wood.

Logs of the largest scantlings, containing 50 or 60 cubic feet, could be obtained in considerable numbers, the limit of size, depending practically only on the limit of the power of transport animals. In the 117,400 acres of *jámbá* forest, referred to in the beginning of this paper, there were, it was estimated, 44,580 trees exceeding 26 inches in diameter at breast-height. The surplus stock, taking the mature size to be 24 inches, is, therefore, very considerable, and the yield for many years will consist of timber of very large scantling.

Central Provinces.

Central Provinces.—In Raipur, the timber is not much appreciated except in cases of necessity, when it is used for house-building. The chief reason is the scarcity of the trees in the division, and the dwarfed nature and unsoundness of those that occur. In the Southern Circle the timber is much sought after for poles and house-building, and lasts well when kept from damp. The reproduction of saplings is most satisfactory and in time the forests in the south of the division will yield a large quantity of timber. The young saplings and poles are very liable to the attacks of a species of **Xylocarpa**, and this insect effects a great deal of damage when the young growth has been weakened by fires and ill-treatment.

Bengal.

Bengal.—The Divisional Forest Officer, Puri, calculates that the timber could be landed at Cuttack, the nearest seaport, at the rate of about R8-8 per ton. About 500 trees, each being estimated to yield about 6 cubic feet, might be expected from this division, this would afford about 165,000 cubic feet or 73½ tons of timber per annum. As the forests are very young, the sizes of the logs would be about 20 to 30 feet in length and 18 to 24 inches in girth. In other parts of the forests, the trees reach a girth of 2½ feet at 4 feet from the ground.

Burma.

Burma—Pegu Circle. A relatively small amount of timber could be delivered at railway stations on the Burma State Railway at R4 or R5 per ton for short lengths, the bulk of the timber is, however, inaccessible owing to the want of roads. From the working-plans of

Value and Yield.

the different reserves the following trees of 6 feet girth are estimated to be standing—

Thonze	Reserve	51,000
Konbilin	„	13,000
Kadin	„	36,000
Mokka	„	22,000
Minhla	„	59,500
Gamon	„	40,000
Bawbin	„	85,000
Taungmyo	„	101,000
Kangyi	„	1,773
		409,273
From the rest of the reserved and unreserved forests may be estimated		190,727
		600,000

Burma.

Or about 1,000,000 tons. These, if they could be extracted, would yield from 30,000 to 40,000 tons a year.

Outturn.

An indication of the actual outturn is afforded in the report on the Forest Department, Burma, for 1897-98, where it is stated that 25,851 tons (of 50 cubic feet) were supplied by this circle. The principal centres of supply were the Tharrawady and Bassein Divisions. The size of the logs that could be delivered would be limited entirely by the roads, but one-ton logs would present no great difficulty. Logs of any size or shape could be procured.

Price at Rangoon.

"The price at which the timber could be supplied free on board in Rangoon is about—

£10 per ton of 50 cubic feet (1·42 cubic metres) for planks of great width, say 24 inches (61 centimetres) and upwards.

£5 per ton for small planks 8 inches × 3 inches (20 centimetres × 8 centimetres) and above.

£4 per ton for smaller planks and planks suitable for conversion into paving blocks."

(*P. J. Carter, Conservator of Forests, Pegu Circle, 1894.*)

South Tenasserim.

The duty on Pyinkado in South Tenasserim Circle is R2-8 per ton, prepaid. The cost of extraction is about R10 per ton (round) delivered in Tavoy. The cost of conversion depends on the scantling

Value and Yield.

required, and varies from R2 a log for squaring to R8 a log for small scantling (logs average 40 to 45 cubic feet). Shipment costs R8 per three tons converted timber. Freight to Rangoon R10, to Calcutta R13, allowing for rejections and loss in conversion. No tenders can be taken here for narrow gauge sleepers lower than R44 to R45 per ton F. O. B. Tavoy anchorage. The sizes run small ; logs are almost all under 7 feet girth.

In the absence of working plans the possible annual outturn can only be roughly estimated. It would probably not be less than 5,000 tons per annum.

Pyinmana.

In the Pyinmana Division, the price of *Pyinkado* is about R30 per ton of 50 cubic feet for sawn sleepers, and R20 per ton for logs. The timber can be cut to any size up to a reasonable limit. The forests would yield about 4,000 tons. The supply, however, is restricted owing to the cost of transport. *Pyinkado* cannot be floated in these parts, and is only worked, except for local requirements, within 10 to 15 miles of the railway. As this timber does not float, it could only be exported in log floated with bamboo, and the bamboo used could be sold on arrival at the market. The Conservator is of opinion that the extraction would not be expensive Any size required could be supplied up to the maximum as the size of five specimens given above. It is hard to say how many tons any forests could give without valuation surveys, and as it is not known how long the trees take to arrive at 6 feet girth at 6 feet from the ground, it can only be surmised that at least 1,000 tons a year, and probably more, could be exported from any division.

The timber in Burma is believed to vary considerably, and that from Katha differs from that supplied in the Pyinmana Division. For instance two logs were sent from the Katha Division by the Conservator of Forests, Eastern Circle, the one (Reg. No. 6669) was the ordinary variety known as *Pyinbo*, and the other (Reg. No. 6670) was a lighter kind, called *Pyinma*.

Uses.

USES OF THE TIMBER.

Railway sleepers.

In Burma and Bengal, *Pyinkado* has been largely employed for making railway sleepers and telegraph posts. Between 1865 and 1868, inclusive, 70,377 sleepers were obtained by the East Indian Railway Company from Arrakan (*Burma Gaz.*). The Burma

Uses.

State Railway was laid with sleepers of this wood in 1877, and the majority of sleepers was still good in 1894 (*P. J. Carter*). In 1876-77 Major Seaton reported that 10,000 sleepers from Arrakan sold in Calcutta at R5 each, while in 1884-85, 17,631 were sold there at R2-1 each. The cost of cutting and freight was said to have amounted to 12 annas per sleeper. In 1885-86, 81,569 sleepers were removed from Burma by Government Agency, of which 75,000 went to Madras and the remainder to Calcutta. The profit which accrued from the works in the Pegu Circle amounted to 36 per cent.

Sleepers.

Building purposes.

A certain amount of scantling is also turned out of the mills in Pegu for building purposes and railway keys. Trees of 3 to 4 feet girth are used as house posts and bridge-piles. For these purposes it is said to be unequalled for its durability.

Street paving.

It has been found to be a most suitable wood for street paving, and one mill in Pegu is supplying planks 9 feet by 3 inches for paving blocks for England.

Implements.

In South Tenasserim and Pyinmana, the Burmans make house and bridge posts and oil presses from the wood, also harrow teeth and yokes for buffaloes.

Boundary boards.

The hardness of the wood has been utilised by Mr. Oliver, Conservator of Forests, as a new form of boundary board. These are made of the wood, pointed at one end, so that they can be driven into trees of softer wood. The refuse of the sleeper works has been used for making tent pegs for the Rangoon Arsenal. Pegs to the number of 14,600 were supplied to the Arsenal during 1897-98 at a cost of R1,321, and the price realized for them was R1,752. Pegs of *gyo* (**Schleichera trijuga**) were tried, but were found inferior to *pyinkado*.

Tent pegs.

Bows.

No small or ornamental articles are made of this wood by the Burmans, except perhaps the Burmese bow.

Carts.

Ship building.

The timber has been used in the Madras Gun-carriage Factory for poles, axle-cases, and cheeks and axle-cases for lighter mortar carts. Captain Puckle said that in 1862 it was used in Mysore for furniture, shafts, plough heads, knees, and crooked timber for shipbuilding. It has also been largely used for making charcoal for iron mines in Shimoga, Mysore.

Charcoal.

XYLIA dolabriformis. — The Iron-wood Tree

Uses.

Joinery.

In Kanara and Malabar the seasoned wood is chiefly used for posts or pillars, beams, rafters, reepers, door and window frames, and occasionally for door or window shutters. It is seldom, if ever, used for furniture or cabinet work. Only well-seasoned logs are worked, otherwise they are difficult to saw, and are liable to warp or crack. The wood is never used for making toys, or even such articles as ladles and domestic articles. The wood is liable to heart-shakes, so much so, that an experiment to supply sleepers of this wood failed on that account, and probably the only use for which the present stock is suitable and available in large quantities, would be for wood pavements where only small pieces are required, and a correspondence with view to a contract is now being carried on with England.

Wood paving.

The timber is used by the natives in the south of the Bombay Presidency, for uprights in the construction of houses, but never for beams, as it is said to warp. It has lately been used for railway sleepers on the Southern Mahratta and Goa Railways, and although it is too soon to express an opinion on its suitability, it may be said that the Railway Engineers are so far pleased with the experiment. It is an excellent burning material. In Bengal the timber affords posts and rafters for house building, and is used for carts and agricultural implements.

Railway sleepers.

TIMBER REFUSE AS A SOURCE OF TANNIN.

As a tanning agent.

A new interest during the past year or two has attached to the Pyinkado timber trade in consequence of the refuse of the sleeper-works in Burma having been found to be astringent and useful for leather manufacture. The full account of this discovery, with notices of the action taken by the Forest Department and that of the Reporter on Economic Products will be found in the following paragraphs :

The " Indian Forester " for September, 1896, p. 354, inserted the following letter from " H. S.," Bangkok, on the subject of " A New Source of Tannin."

" I last year forwarded to the Director of the Dehra Dún School a sample of a cutch-looking substance which I asked him to kindly have analysed. I have just received his reply in which he says : " The Agricultural Chemist was good enough to examine the extract you sent, and reports that it contains 89·5 per cent. of tannin by Lowenthal's method. The extract was obtained for me by Maung

Tanning material.

Kale, K.S.M. of Zigon, Burma, by boiling chips of *Pyinkado* (**Xylia dolabriformis**) in the same way that chips of cutch are boiled. but I have no information as to which part of the tree was used. Compared with cutch, which Watt says yields from 45 to 55 per cent. of tannin, the *Pyinkado* extract would appear exceedingly rich in tannin and worthy of further enquiry. Hundreds of tons of *Pyinkado* bark, and sawdust are annually carted away as refuse from the saw mills in Burma, and experiments might be carried out to see if tannin could be extracted from this waste product in paying quantities. I regret that my absence from Burma prevents me from personally prosecuting the enquiry."

Extracts from Pyinmana.

The Deputy Conservator of Forests, Pyinmana Division, sent to the Reporter on Economic Products certain extracts of *Kath* (**Acacia Catechu**), *In* (**Dipterocarpus**), *Taukkyan* (**Terminalia tomentosa**) and **Xylia**, and at the same time forwarded particulars of their manufacture.

Proportion of extract.

From two tons of **Xylia** chips he separated 97$\frac{3}{4}$ lbs. of extract, or 4·3 per cent., from two tons of old sawdust 33 lbs., or 1·4 per cent., and from two tons of fresh sawdust 58$\frac{1}{4}$ lb. or 2·4 per cent. Taking into account the large quantities of water in the finished extract, it will be seen that in the manufacture on a large scale the amounts fell far below the laboratory results, which might be taken as the standard.

Proportion of tannin in extract.

Mr. Procter has found 32 per cent. of tannin in his analysis of the **Xylia** extract. Taking these figures and eliminating the water, it can readily be calculated that the absolutely dried extract contained 76·37 per cent. of tannin. This result then does not seriously conflict with that obtained by the Agricultural Chemist quoted in the extract above. That officer found 89·5 parts of tannin in 100 of extract which, it is presumed, was reckoned as free from moisture. In the analysis of the raw material quoted below it is evident that the dried products derived from the sawdust and chips yielded, respectively, 87·1 and 90 per cent. of tannin.

Analysis of wood and chips.

Before remarking on the analysis of extracts of Pyinkado made by Professor Procter of the Yorkshire College, Leeds, it will be well to draw attention to the value of the raw material. The Conservator of Forests, Pegu Circle, Burma, in February 1898 supplied this office with sawdust and chips, the waste wood and branches of **Xylia**

XYLIA dolabriformis. — The Iron-wood Tree

Tanning material.

dolabriformis, these specimens were examined in the Economic Laboratory, Indian Museum, and the following report was made—

	Tannin.	Extract.	Moisture.	Ash.
Sawdust (Reg. No. 10442)	6·1	7·0	9·1	2·4
Chips (10442-1) . .	5·4	6·0	8·0	4·1
Sawdust (11408) . .	·8	1·0	20·8	2·2
Chips (11408-1) . .	4·6	5·7	5·6	2·9

The proportions of extract in the wood are very poor when compared with other materials, *e.g.*, **Acacia Catechu**, but there is a large proportion of tannin in the extract calculated from the above figures. The samples are fairly uniform in composition with the exception of the dust (No. 11408). This specimen was damp and mouldy, and the analysis represents the detrimental influence of these conditions in effecting a loss of tannin when articles of this nature are exposed for any length of time.

Mr. Procter's Report.

From **Mr. H. R. Procter**, *Leather Industries Laboratory, Yorkshire College, Leeds, to the Director, Royal Gardens, Kew, dated 9th February 1898.*

I now enclose you analysis and colour test of the **Xylia dolabriformis** extract which I think may prove a valuable tanning material as it contains a large quantity of tannin, and the colour is a very fair one. If the extract can be obtained in commercial quantities, I think there should be no great difficulty in inducing some tanner to make a practical experiment with it, and I shall be glad to do anything that I can in the matter. I may probably be making further experiments on the sample you have sent me, and I will communicate any results which I may obtain. I also believe that **Mr. Perkin** is making some investigation in the Dyeing Research Laboratory of this College on its colouring matters.

Enclosure.

Analysis.

The following are the results of an analysis of your sample of **Xylia dolabriformis** extract (marked "Pyinkado,") according to the method of the International Association of Leather Trade Chemists :—

Tanning matters absorbed by hide . . .	32·0
Soluble non-tanning matters	4·9
Insoluble (at 60 deg. Fahr.)	5·0
Water	58·1
	100·0

of Pegu and Arrakan. (*H. R. Procter.*) XYLIA dolabriformis.

Mr. Procter's Report.

In its low percentage of soluble non-tannin, as well as in colour, it resembles Quebracho. It might become a very useful tanning material.

The colour of a solution containing 0·5 per cent. of tanning matter as determined by the above analysis, measured by the tintometer in a cell one centimeter thick, is red 4·0, yellow 8·8, black 0·7, and a sample of leather tanned in a one per cent. solution is annexed. This colour is reddish but not more so than Quebracho or Mimosa."

The foregoing report of Professor Procter proves that Pyinkado extract is rich in tannin, the colour is good, and it is a satisfactory tanning agent. But with such a small yield of extractive matter in the wood, the question of making it at a profit turns on the cost of the sawdust. If the sawdust is really a waste product the manufacture might be attempted, but if any considerable value is attached to the raw article the finished product is not likely to compete with recognized trade articles.

The Inspector General of Forests has since written to say that the bark and sawdust are obtained in considerable quantity as a waste product of the saw mills, and that there would be no difficulty in making large quantities of the cutch-like extract.

X. 16-20.

G. I. C. P. C.—No. 408 R. & A.—5-2-1900.—2,230.—B. N. D.

(Vegetable Product Series, No. 52.)

(Oils & Oil-seeds.)

THE

AGRICULTURAL LEDGER.

1899—No. 12.

INDIAN EDIBLE OILS.

[*Dictionary of Economic Products, Vol. V.*, O. 84.]

EDIBLE OILS USED IN INDIA.

A Report on their chemical and physical examination by PROFESSOR WYNDHAM R. DUNSTAN, F.R.S., *Director of the Scientific Department, Imperial Institute. Also an Introductory Note by* THE EDITOR.

Origin of inquiry.

Indent of Imperial Institute.

The investigation into the chemical and physical properties of Indian edible oils was commenced in 1895. On the 3rd April of that year, Sir F. A. Abel, Bart., K.C.B., Secretary and Director of the Imperial Institute, addressed the following letter, Flying Seal Series No. 43, to the Secretary to the Government of India, Revenue and Agricultural Department.

"It has been reported to me by the Curator of the Indian Section, that enquiries have recently been made for samples of various Indian edible oils, more especially those obtained from the Bassias (**Bassia latifolia, B. longifolia,** and **B. butyracea**) and from **Garcinia indica** (kokam butter)."

"I would, therefore, suggest that it would be advisable to deal with the entire subject of Indian edible oils in the next programme, and to send, in due course, to the Imperial Institute, samples of the oils above named as well as of other edible Indian oils, in sufficient quantity to allow of a supply being available in store to meet the demands of enquiries for samples."

"It will not be necessary to send the oils of **Arachis hypogæa** or of **Sesamum indicum,** as there is already a sufficient quantity of these in store, but the oils of **Carthamus tinctorius, Guizotia**

Action taken in India.

abyssynica, and the oil known as Bengal mustard oil, might be included in the consignment."

The enquiry from London was made over in the usual way to the Reporter on Economic Products who considerably extended the list so as to make it as complete as possible. On the 15th May Sir F. A. Abel was informed of the action taken, and that arrangements had been made to procure for the Imperial Institute the following kinds of edible oils more or less commonly used in the country :—

Aleurites moluccana.—Rare. Samples asked from the Forest Department.

Anacardium occidentale.—Samples asked from Madras.

Bassia butyracea.—Samples asked from North-Western Provinces.

Bassia latifolia.—Samples asked from Bengal, North-Western Provinces, Central Provinces, and Bombay, and also from the Forest Department.

Bassia longifolia.—Samples asked from Madras, and also from the Forest Department.

Brassica sp.—Different kinds of mustard oil. Samples asked from all the Provinces.

Buchanania latifolia.—Samples asked from Central Provinces, and also from the Forest Department.

Carthamus tinctorius.—Samples asked from Bengal, North-Western Provinces, Panjáb, and Bombay.

Cocos nucifera.—Samples asked from Bengal, Bombay, and Madras.

Eruca sativa.—Samples asked from the North-Western Provinces.

Garcinia sp.—Kokum butter. Samples asked from Bombay, and also from the Forest Department.

Guizotia abyssynica.—Samples asked from Bengal and the Central Provinces.

Papaver somniferum.—Poppy oil. Samples asked from Bengal and the North-Western Provinces.

Prunus sp.—Apricot and peach oils. Samples asked from Panjáb.

Inquiries were also instituted with regard to other kinds of less known edible oils found in the different Provinces.

Two gallons were asked of each kind of oil, together with 10 lbs. of seed or kernel, as also the whole of the oil-cake produced in expressing the above quantity of oil. The greater part of this collection would be sent to the Imperial Institute, except a portion of each sample, which it was intended to keep in the Indian Museum.

Despatch of Specimens.

On the 1st November 1895, the first consignment of oils was forwarded to the Imperial Institute, and further quantities were despatched as soon as they were received in the Indian Musuem. In 1898 when the work of collecting was near completion, the Honorary Secretary, on the 12th March, sent the following letter No. $\frac{102}{4}$ to the Reporter :—" In connection with the investigation of Indian Edible Oils Professor Dunstan requires exact information as to the methods which have been adopted in obtaining the various oils from the plants. I shall be much obliged if you will kindly send this information at as early a date as possible, as Professor Dunstan is nearly ready to make a report on this subject."

Inquiry as to method pursued.

The Officiating Reporter (D. Hooper, Esq.,) by his letter No. 1370—110 F. S., dated 9th June 1898, replied as follows :—

With reference to letter No. 102—4 (F. S. S. No. 135), dated the 12th March 1898, I have the honour to send you all the information I possess regarding the edible oils (Imperial Institute Programme No. 47) collected for the Research Department.

Country oil-mill or Kolhu.

In very few cases is the method of extracting the oil described in detail, since the country oil-mill ("*Kolhu*") was generally used and its mechanism is supposed to be thoroughly understood. The "*Kolhu*" is composed of two parts; the mortar, which is fixed, containing the seed,—a piece of wood like a large pestle which is made to rotate inside the mortar and crush the contents. The mortar is constructed of stone or wood, and the pestle is worked by one or two bullocks according to the size of the mill. The seeds are decorticated and placed in the mortar-like vessel, they are then ground to a paste and the oil, as it separates, is allowed to run off through an aperture below. The oil is decanted from dregs, if there are any, but no process of filtering is resorted to.

Weight of oil and cake after expression.

The total weight of oil and oil-cake often exceeds the weight of the seeds taken to supply the mill; this is due to the employment of small quantities of water to facilitate the disengagement of the oil.

A difficulty was experienced in one or two cases where the oil had a thick consistence at ordinary temperatures and could not readily be separated in the usual way. The Forest Ranger, Koderma, Bengal, for instance, heated the powdered kernels of **Buchanania latifolia** in an earthen pot by placing it over another pot in which water was kept boiling. The pasty mass was taken out, placed in a bag and

Other methods of extracting the oil.

pressed firmly between two planks. This crude process occasioned a fairly satisfactory yield of oil. At another instance, in Rajamundry, Madras, the kernels of **B. latifolia** were boiled with water and the oil which rose and collected on the surface was removed.

In Bahraich, North-Western Provinces, the addition of hot water to **Buchanania** seeds, as they were being pressed in the mill, was found to promote the separation of oil.

This is all the information I am able to give you with regard to the processes adopted by the various officials who have supplied the samples of seeds, oil and oil-cake.

In conclusion, I have the honour to append two statements: the first shows the actual proportions of oil yielded by most of the collections; the second gives a complete list of all the samples collected by this Department for the Imperial Institute.

Yield of oil per cent.

Percentage yield of oil from various Indian seeds, samples of which have been supplied to the Scientific Department, Imperial Institute.

Bassia latifolia (Mahua)—

Cawnpur, North-Western Provinces	27·0
North-Western Provinces	28·3
Central Provinces	30·7
Dumraon, Bengal	33·3
Bombay	37·7

B. longifolia (Illippe)—

Coimbatore, Madras	18·0
Tanjore „	46·0 (estimated).

Brassica species—

White mustard? (*B. campestris*, var. *sarson*), Bengal	33·6
Black mustard? (*B. juncea*)	28·5
Lutni (*B. Napus*, var. *oleipera*), Bengal	32·5
Rai (*B. juncea*)	22·2
Toria (*B. campestris*), Umballa, Panjáb	33·3
Mustard (*B. juncea*?), Central Provinces	26·4
B. Napus (yellow), Bombay	40·0
B. Napus (brown), „	36·4
B. juncea, „	21·1

Edible Oils used in India. OILS & FATS.

	Yield of oil per cent.
Buchanania latifolia (Chironji, pial)—	
Koderma, Bengal	25·0
Narsinghpur, Central Provinces	25·0
Nimar, „	27·7
Bundelkhand, North-Western Provinces	30·3
Bahraich, „ „	37·0
„ „ „	39·6
„ „ „	40·0
Carthamus tinctorius (safflower)—	
Central Provinces	23·7
Cocos nucifera—	
Bengal	52·3
Bombay	57·1
Eruca sativa (Taramira)—	
Umballa, Panjáb	12·5
Bombay	25·0
North-Western Provinces	25·3
Garcinia indica (Kokam)—	
Bombay	33·3
Guizotia abyssynica (Ramtil, Niger seed)—	
Bombay	23·8
Bengal	26·0
Central Provinces	27·5
Juglans regia (Walnut)—	
Panjáb	50·0
Linum usitatissimum (Linseed)—	
Central Provinces	28·2
Olea cuspidata (Zaitun)—	
Panjáb	11·2
Papaver somniferum (Poppy)—	
Bengal	33·3
North-Western Provinces	39·6
Umballa, Panjáb	47·0

Samples despatched to Imperial Institute.

Register of Collections of Edible Oils sent to the Imperial Institute.

	Registration No.	Description of Article and Name of Province.	Quantity.	Action taken.
Madras.		*From Deputy Collector of Tanjore through the Revenue Secretary and Director, Land Records and Agriculture, Madras.*		
	6815	**Anacardium occidentale**, nuts .	5 lbs.	I. I. Invoice No. 15 of 1896.
	6816	Ditto oil .	11 bottles	Ditto.
N.-W. P.		*From Government Farm, Cawnpur.*		
	7059	**Bassia butyracea**, oil . . .	21 lbs.	I. I. Invoice No. 22 of 1896.
Bengal.		*From Calcutta Oil Merchant.*		
	6330	**Bassia latifolia**, oil . . .	1 tin	I. I. Invoice No. 10 of 1895.
		From Dumraon Farm.		
	6452	**Bassia latifolia**, oil . . .	18 lbs. 8 oz.	I. I. Invoice No. 13 of 1895.
	6453	Ditto nuts . . .	6 lbs.	Ditto.
	6454	Ditto oil-cake . .	20 lbs.	Ditto.
N.-W. P.		*From Government Farm, Cawnpur.*		
	6544	**Bassia latifolia**, seeds . . .	6 lbs.	I. I. Invoice No. 13 of 1895.
	6545	Ditto oil . . .	16 lbs. 8 oz.	Ditto.
	6546	Ditto oil-cake . .	33 lbs.	Ditto.
Madras.		*From Collector of Bellary.*		
	6633	**Bassia latifolia**, seeds, husked .	6 lbs.	I. I. Invoice No. 13 of 1895.
	6634	Ditto oil . . .	8 lbs. 8 oz.	Ditto.
	6635	Ditto oil-cake . .	6 lbs.	Ditto.

Register of Collections of Edible Oils sent to the Imperial Institute—continued.

Registration No.	Description of Article and Name of Province.	Quantity.	Action taken.	Samples despatched to Imperial Institute.
	From Central Provinces.			Central Provinces.
6744	**Bassia latifolia**, oil . . .	1 tin	I. I. Invoice No. 15 of 1895.	
6745	Ditto refuse oil-cake .	20 lbs.	Ditto.	
	From Coimbatore, Madras.			Madras.
6749	**Bassia latifolia**, seeds . . .	9 lbs.	I. I. Invoice No. 15 of 1895.	
6750	Ditto oil . . .	12 bottles	Ditto.	
6751	Ditto oil-cake . .	15 lbs.	Ditto.	
	From Conservator of Forests, Southern Circle, Central Provinces.			Central Provinces.
6963	**Bassia latifolia**, seeds . . .	8 lbs.	I. I. Invoice No. 15 of 1895, and No. 17 of 1896.	
	Survey Commissioner, Bombay.			Bombay.
7757	**Bassia latifolia**, oil . . .	18 lbs.	I. I. Invoice No. 22 of 1896.	
	From Commissioner of Settlements and Director, Land Records and Agriculture, Central Provinces.			Central Provinces.
8396	**Bassia latifolia**, seeds, husked .	6 lbs. 8 oz.	I. I. Invoice No. 22 of 1896.	
8397	Ditto do., unhusked .	14 oz.	Ditto.	
8398	Ditto oil . . .	13 lbs. 5 oz.	Ditto.	
8399	Ditto oil-cake . .	26 lbs. 5 oz.	Ditto.	

Samples despatched to Imperial Institute.

***Register of Collections of Edible Oils sent to the Imperial Institute*—continued.**

	Registration No.	Description of Article and Name of Province.	Quantity.	Action taken.
Madras.		*From Tahsildar of Tanjore.*		
	6977	**Bassia longifolia**, oil . . .	24 lbs. 14 oz.	I. I. Invoice No. 22 of 1896.
	6978	Ditto oil-cake . .	9 lbs. 6 oz.	I. I. Invoice No. 17 of 1896.
	6979	Ditto seeds . .	4 lbs. 7 oz.	I. I. Invoice No. 20 A of 1896.
Assam.		*From Golaghat Mills.*		
	6359	**Brassica juncea**, seeds . .	6 lbs.	I. I. Invoice No. 13 of 1895.
	6360	Ditto oil . . .	16 lbs. 8 oz.	Ditto.
	6361	Ditto oil-cake . .	50 lbs.	Ditto.
Bengal.		*From Director, Land Records and Agriculture, Bengal.*		
	6373	**Brassica ? campestris**, var. **sarson**, seeds . . .	5 lbs.	I. I. Invoice No. 13 of 1895.
	6374	Ditto oil . . .	20 lbs.	Ditto.
	6375	Ditto oil-cake . .	20 lbs.	Ditto.
	6376	**Brassica ? juncea**, seeds . .	5 lbs.	Ditto.
	6377	Ditto oil . . .	18 lbs. 8 oz.	Ditto.
	6378	Ditto oil-cake . .	22 lbs. 8 oz.	Ditto.
	6379	**B. Napus**, seeds	5 lbs.	Ditto.
	6380	Ditto oil	18 lbs.	Ditto.
	6381	Ditto oil-cake . . .	24 lbs. 8 oz.	Ditto.

***Register of Collections of Edible Oils sent to the Imperial Institute*—continued.**

Registration No.	Description of Article and Name of Province.	Quantity.	Action taken.	Samples despatched to Imperial Institute.
	From Director, Land Records and Agriculture, Bengal—concld.			Bengal.
6382	**Brassica juncea**, seeds . . .	5 lbs.	I. I. Invoice No. 13 of 1895.	
6383	Ditto oil . . .	18 lbs. 8 oz.	Ditto.	
6384	Ditto oil-cake . .	38 lbs.	Ditto.	
	From Government Farm, Cawnpur.			N.-W. P.
6431	**Brassica campestris**, var. **glauca**, seeds . . .	6 lbs.	I. I. Invoice No. 13 of 1895.	
6432	Ditto oil . . .	16 lbs. 8 oz.	Ditto.	
6433	Ditto oil-cake . .	20 lbs.	Ditto.	
6434	Ditto *var.* **dichotoma**, seeds .	6 lbs.	Ditto.	
6435	Ditto oil .	16 lbs. 8 oz.	Ditto.	
6436	Ditto oil-cake .	27 lbs.	Ditto.	
6437	Ditto red seeds	6 lbs.	Ditto.	
6438	Ditto oil .	16 lbs. 8 oz.	Ditto.	
6439	Ditto oil-cake	23 lbs.	Ditto.	
	From the Deputy Commissioner, Umballa, Panjáb.			Panjab.
7152	**Brassica campestris**, seeds . .	5 lbs. 5 oz.	I. I. Invoice No. 22 of 1896.	
7153	Ditto oil . .	20 lbs. 11 oz.	Ditto.	
7154	Ditto oil-cake .	32 lbs. 11 oz.	Ditto.	

OILS & FATS. Edible Oils used in India.

Samples despatched to Imperial Institute.

Register of Collections of Edible Oils sent to the Imperial Institute—continued.

	Registration No.	Description of Article and Name of Province.	Quantity.	Action taken.
Central Provinces.		*From Commissioner of Settlements and Agriculture, Central Provinces.*		
	7620	**Brassica ? nigra,** seeds . . .	5 lbs. 2 oz.	I.I. Invoice No. 20A of 1896.
	7620A	Ditto oil . . .	8 lbs. 4 oz.	I. I. Invoice No. 22 of 1896.
	7620B	Ditto oil-cake . .	14 lbs. 14 oz.	Ditto.
Bombay.		*From Survey Commissioner, Bombay.*		
	7758	**Brassica campestris,** yellow variety, seeds . .	5 lbs. 15 oz.	I. I. Invoice No. 22 of 1896.
	7758A	Ditto oil . .	20 lbs.	Ditto.
	7758B	Ditto oil-cake .	14 lbs. 14 oz.	Ditto.
	7759	Ditto brown variety, seeds	4 lbs. 12 oz.	Ditto.
	7759A	Ditto oil . .	20 lbs. 2 oz.	Ditto.
	7759B	Ditto oil-cake .	18 lbs. 3 oz.	Ditto.
	7760	**Brassica juncea,** seeds . . .	5 lbs. 4 oz.	Ditto.
	7760A	Ditto oil . . .	20 lbs. 2 oz.	Ditto.
	7760B	Ditto oil-cake . .	39 lbs. 12 oz.	Ditto.
N.-W. P.		*From Conservator of Forests, Bundelkhund Division, Jhansi.*		
	6642	**Buchanania latifolia,** seeds . .	5 lbs.	I. I. Invoice No. 14 of 1895.
	6643	Ditto oil . .	10 bottles	Ditto.
	6644	Ditto oil-cake .	20 lbs.	Ditto.

Register of Collections of Edible Oils sent to the Imperial Institute – continued.

Registration No.	Description of Article and Name of Province.	Quantity.	Action taken.	Samples despatched to Imperial Institute.
	From Assistant Conservator of Forests, Bahraich Division, North-Western Provinces.			N.-W. P.
8031	**Buchanania latifolia,** oil-cake .	4 lbs. 14 oz.	I. I. Invoice No. 22 of 1896.	
8032	Ditto oil . .	4 bottles	Ditto.	
	From Commissioner of Settlements and Agriculture, Central Provinces.			Central Provinces.
8400	**Buchanania latifolia,** seeds . .	7 lbs. 6 oz.	I. I. Invoice No. 22 of 1896.	
8401	Ditto oil-cake .	4 lbs. 6 oz.	Ditto.	
	From Divisional Forest Officer, Bhandara, Central Provinces.			
8687	**Buchanania latifolia,** seeds . .	1 lb. 10 oz.	I. I. Invoice No. 13 of 1897.	
	From Assistant Conservator of Forests, Gonda Division.			Oudh.
9363	**Buchanania latifolia,** seeds . .	1 lb. 10 oz.	I. I. Invoice No. 13 of 1897.	
	From Divisional Forest Officer, Nimar, through Conservator of Forests, Northern Circle, Central Provinces.			N.-W. P.
9368	**Buchanania latifolia,** oil . .	1 bottle	I. I. Invoice No. 13 of 1897.	
	From Officer in charge Bundelkhund Division, Jhansi.			
9425	**Buchanania latifolia,** seeds . .	1 lb. 1 oz.	I. I. Invoice No. 26 of 1897.	

Samples despatched to Imperial Institute.

***Register of Collections of Edible Oils sent to the Imperial Institute*—continued.**

	Registration No.	Description of Article and Name of Province.	Quantity.	Action taken.
Bombay.		*From Sub-Divisional Officer, Poona, Bombay.*		
	9725	**Buchanania latifolia**, seeds . .	1 lb.	I. I. Invoice No. 26 of 1897.
Bengal.		*From Forest Ranger, Koderma, Hazaribagh.*		
	9727	**Buchanania latifolia**, seeds . .	1 lb. 3 oz.	I. I. Invoice No. 26 of 1897.
	9727—1	Ditto oil . .	1 pint	I. I. Invoice No. 31 of 1897.
N.-W. P.		*From Deputy Conservator of Forests, Gorakhpur, North-Western Provinces.*		
	9828	**Buchanania latifolia**, seeds . .	1 lb. 15 oz.	I. I. Invoice No. 1 of 1898.
		From Deputy Conservator of Forests, School Circle, Dehra Dun.		
	9836	**Buchanania latifolia**, oil . .	1 phial	I. I. Invoice No. 31 of 1897.
Madras.		*From Conservator of Forests, Central Circle, Madras.*		
	9982	**Buchanania latifolia**, seeds . .	1 lb. 6 oz.	I. I. Invoice No. 1 of 1898.
	9984	Ditto oil . .	2 oz.	Not sent.
Bombay.		*From Divisional Forest Officer, W. Khandesh, Bombay.*		
	10060	**Buchanania latifolia**, seeds . .	1 lb.	I. I. Invoice No. 1 of 1898.
N.-W. P.		*From Divisional Forest Officer, Bahraich, North-Western Provinces.*		
	10225	**Buchanania latifolia**, oil . .	4 bottles	I. I. Invoice No. 54 of 1899.
	10226	Ditto oil-cake .	1 lb. 12 oz.	I. I. Invoice No. 37 of 1898.
	10227	Ditto seeds . .	3 lbs. 12 oz.	I. I. Invoice No. 1 of 1898.

***Register of Collections of Edible Oils sent to the Imperial Institute*—continued.**

Registration No.	Description of Article and Name of Province.	Quantity.	Action taken.	Samples despatched to imperial Institute.
	District Forest Officer, Nellore.			**Madras.**
10350	**Buchanania latifolia**, seeds .	20 lbs. 10 oz.	I. I. Invoice No. 1 of 1898.	
	From Deputy Commissioner, Peshawar.			
5124	**Carthamus Oxyacantha**, seeds	2 lbs.	Invoice No. 8 of 1895.	
5125	Ditto oil .	2 lbs.	Ditto.	
	From Deputy Commissioner, Hoshiarpur District Panjáb.			**Panjab.**
6296	**Carthamus tinctorius**, cultivated plant, oil	11 lbs. 4 oz.	I. I. Invoice No. 13 of 1895.	
6297	Ditto oil-cake .	20 lbs.	Ditto.	
6298	Ditto seeds . .	12 lbs.	Ditto.	
6299	Ditto wild plant, oil	12 ozs.	Ditto.	
6300	Ditto oil-cake .	10 lbs.	Ditto.	
6301	Ditto seeds . .	5 lbs.	Ditto.	
	From Deputy Commissioner, Umballa District, Panjáb.			
6455	**Carthamus tinctorius**, seeds . .	8 oz.	I. I. Invoice No. 13 of 1895.	
6457	Ditto oil . .	3 bottles	Ditto.	
6458	Ditto oil-cake .	8 lbs.	Ditto.	
	From Superintendent, Land Records and Agriculture, Sind.			**Sind.**
6525	**Carthamus tinctorius**, seeds . .	6 lbs.	I. I. Invoice No. 13 of 1895.	
6526	Ditto oil . .	25 lbs. 8 oz.	Ditto.	

Samples despatched to Imperial Institute.

***Register of Collections of Edible Oils sent to the Imperial Institute*—continued.**

	Registration No.	Description of Article and Name of Province.	Quantity.	Action taken.
		From Survey Commissioner and Director, Land Records and Agriculture, Bombay.		
Bombay.	6624	**Carthamus tinctorius**, oil from dye-plant seed.	43 lbs. 8 oz.	I. I. Invoice No. 13 of 1895.
	6625	Ditto do. from seed of the oil-seed plant.	43 lbs. 8 oz.	Ditto.
	6626	Ditto seeds, dye-plant.	48 lbs.	Ditto.
	6627	Ditto do., oil-seed plant.	48 lbs.	Ditto.
	6628	Ditto oil-cake from seed of the oil-seed plant.	2 lbs. 8 oz.	Ditto.
	6629	Ditto do. . .	48 lbs.	Ditto.
	6630	Ditto do. from seed of dye-plant.	48 lbs.	Ditto.
Madras.		*From Collector of Bellary, through Board of Revenue, Madras.*		
	6681	**Carthamus tinctorius**, seeds . .	4 lbs.	I. I. Invoice No. 14 of 1895.
	6682	Ditto oil . .	2 bottles	Ditto.
	6683	Ditto oil-cake .	20 lbs.	Ditto.
N.-W. P.		*From Government Farm, Cawnpur.*		
	6784	**Carthamus tinctorius**, thornless variety, seeds.	30 lbs.	I. I. Invoice No. 15 of 1895.
	6785	Ditto oil . .	1 tin	Ditto.
	6786	Ditto oil-cake .	1 bag	Ditto.
	6787	Ditto thorny variety, oil.	1 tin	Ditto.
	6788	Ditto oil-cake .	70 lbs.	Ditto. and No. 17 of 1896.
	6986	Ditto seeds . .	30 lbs.	Ditto.

***Register of Collections of Edible Oils sent to the Imperial Institute*—continued.**

Registration No.	Description of Article and Name of Province.	Quantity.	Action taken.	Samples despatched to Imperial Institute.
	From Commissioner of Settlements, Nagpur, Central Provinces.			Central Provinces.
7623	**Carthamus tinctorius**, seeds . .	6 lbs. 11 oz.	I. I. Invoice No. 22 of 1896.	
7623A	Ditto oil . .	9 lbs.	Ditto.	
7623B	Ditto oil-cake .	17 lbs. 12 oz.	Ditto.	
	From Dumraon Farm, through Director, Land Records and Agriculture, Bengal.			Bengal.
8318	**Carthamus tinctorius**, seeds . .	1 lb. 13 oz.	I. I. Invoice No. 22 of 1896.	
8319	Ditto oil (pressed) .	30 lbs.	Ditto.	
8320	Ditto oil (distilled) .	30 lbs.	Ditto.	
	From Director, Land Records and Agriculture, Burma.			Burma.
9104	**Carthamus tinctorius**, seeds . .	1 lb. 1 oz.	I. I. Invoice No. 11 of 1897.	
9104A	Ditto do. . .	5 oz.	Ditto.	
9104B	Ditto do. . .	1 lb. 4 oz.	Ditto.	
9104C	Ditto do. . .	3 oz.	Not sent.	
9104D	Ditto do. . .	1 lb. 3 oz.	I. I. Invoice No. 11 of 1897.	
9104E	Ditto do. . .	6 oz.	Not sent.	
9153	Ditto do. . .	8 oz.	I. I. Invoice No. 11 of 1897.	
9154	Ditto do. . .	6 oz.	Ditto.	
10048	Ditto do. . .	3 lbs.	Not sent.	

OILS & FATS. **Edible Oils used in India.**

Samples despatched to Imperial Institute.

***Register of Collections of Edible Oils sent to the Imperial Institute*—continued.**

	Registration No.	Description of Article and Name of Province.	Quantity.	Action taken.
Bengal.		*From Director, Land Records and Agriculture, Bengal.*		
	6364	**Cocos nucifera**, dried kernel . .	4 lbs.	I. I. Invoice No. 13 of 1895.
	6365	Ditto oil . . .	20 lbs.	Ditto.
	6366	Ditto oil-cake . .	10 lbs.	Ditto.
Madras.		*From Malabar District.*		
	6604	**Cocos nucifera**, kernel . .	6 lbs.	I. I. Invoice No. 13 of 1895.
	6605	Ditto oil . . .	5 lbs.	Ditto.
	6606	Ditto oil-cake . .	6 lbs.	Ditto.
Bombay.		*From Survey Commissioner and Director, Land Records and Agriculture, Bombay.*		
	7761	**Cocos nucifera**, kernel .	5 lbs. 7 oz.	I. I. Invoice No. 22 of 1896.
	7761A	Ditto oil . . .	7 lbs. 12 oz.	Ditto.
	7761B	Ditto oil-cake . .	3 lbs. 10 oz.	Ditto.
N.-W. P.		*From Government Farm, Cawnpur.*		
	6489	**Eruca sativa**, seeds . . .	6 lbs.	I. I. Invoice No. 13 of 1895.
	6490	Ditto oil . . .	16 lbs. 8 oz.	Ditto.
	6491	Ditto oil-cake . .	35 lbs.	Ditto.

Register of Collections of Edible Oils sent to the Imperial Institute—continued.

Registration No.	Description of Article and Name of Province.	Quantity.	Action taken.	Samples despatched to Imperial Institute.
	From Deputy Commissioner, Umballa, Panjáb.			Panjab.
7149	**Eruca sativa**, seeds . . .	8 lbs. 9 oz.	I. I. Invoice No. 22 of 1896.	
7150	Ditto oil . . .	18 lbs. 8 oz.	Ditto.	
7151	Ditto oil-cake . . .	42 lbs. 8 oz.	Ditto.	
	From Survey Commissioner and Director, Land Records and Agriculture, Bombay.			Bombay.
7762	**Eruca sativa**, seeds . . .	7 lbs. 2 oz.	I. I. Invoice No. 22 of 1896.	
7762A	Ditto oil . . .	21 lbs. 7 oz.	Ditto.	
7762B	Ditto oil-cake . . .	33 lbs. 5 oz.	Ditto.	
	From Survey Commissioner and Director, Land Records and Agriculture, Bombay.			
7763	**Garcinia indica**, seeds . . .	6 lbs. 2 oz.	I. I. Invoice No. 22 of 1896.	
7763A	Ditto oil . . .	14 lbs. 15 oz.	Ditto.	
7763B	Ditto oil-cake . .	5 lbs. 14 oz.	Ditto.	
	From Director, Land Records and Agriculture, Bengal.			Bengal.
6367	**Guizotia abyssynica**, seeds . .	5 lbs.	I. I. Invoice No. 13 of 1895.	
6368	Ditto oil . .	20 lbs.	Ditto.	
6369	Ditto oil-cake .	40 lbs.	Ditto.	

Samples despatched to Imperial Institute.

***Register of Collections of Edible Oils sent to the Imperial Institute*—continued.**

	Registration No.	Description of Article and Name of Province.	Quantity.	Action taken.
Central Provinces.		*From Commissioner of Settlements and Agriculture, Central Provinces.*		
	7621	**Guizotia abyssynica**, seeds . .	3 lbs. 10 oz.	I. I. Invoice No. 22 of 1896.
	7621A	Ditto oil . .	10 lbs. 6 oz.	Ditto.
	7621B	Ditto oil-cake .	19 lbs. 3 oz.	Ditto.
Madras.		*From Bellary, Madras.*		
	7711	**Guizotia abyssynica**, seeds . .	1 lb.	Not sent.
	7711A	Ditto oil . .	12 lbs. 14 oz.	Ditto.
	7711B	Ditto oil-cake .	28 lbs. 6 oz.	Ditto.
Bombay.		*From Survey Commissioner and Director, Land Records and Agriculture, Bombay.*		
	7764	**Guizotia abyssynica**, seeds . .	4 lbs. 7 oz.	I. I. Invoice No. 22 of 1896.
	7764A	Ditto oil . .	21 lbs. 4 oz.	Ditto.
	7764B	Ditto oil-cake .	28 lbs. 2 oz.	Ditto.
Bengal.		*From Director, Land Records and Agriculture, Bengal.*		
	7982	**Guizotia abyssynica**, oil . .	17 lbs. 13 oz.	I. I. Invoice No. 22 of 1896.
	7982A	Ditto oil-cake .	25 lbs. 8 oz.	Ditto.

***Register of Collections of Edible Oils sent to the Imperial Institute*—continued.**

Registration No.	Description of Article and Name of Province.	Quantity.	Action taken.	Samples despatched to Imperial Institute.
	From Director, Land Records and Agriculture, North-Western Provinces and Oudh.			N.-W. P.
8279	**Guizotia abyssynica**, oil . .	14 lbs. 7 oz.	I. I. Invoice No. 22 of 1896.	
8280	Ditto seeds . .	7 lbs. 12 oz.	Ditto.	
	From Deputy Commissioner, Kohat, Panjáb.			Panjab.
7157	**Juglans regia**, nut . . .	6 lbs. 4 oz.	I. I. Invoice No. 20A of 1896.	
7158	Ditto oil . . .	6 bottles.	I. I. Invoice No. 22 of 1896.	
7159	Ditto oil-cake . .	5 lbs. 13 oz.	I. I. Invoice No. 20A of 1896.	
	From Commissioner of Settlements and Agriculture, Central Provinces.			Central Provinces.
7622	**Linum usitatissimum**, seeds . .	6 lbs. 10 oz.	Invoice No. 22 of 1896.	
7622A	ditto oil . .	9 lbs.	Ditto.	
7622B	ditto oil-cake .	7 lbs.	Ditto.	
7160	**Olea cuspidata**, seeds . . .	10 lbs.	I. I. Invoice No. 20A of 1896.	
7161	Ditto oil . . .	4 bottles.	I. I. Invoice No. 22 of 1896.	
7162	Ditto oil-cake . .	24 lbs. 13 oz.	Ditto.	
	From Director, Land Records and Agriculture, Bengal.			Bengal.
6370	**Papaver somniferum**, seeds . .	5 lbs.	I. I. Invoice No. 13 of 1895.	
6371	Ditto oil . .	18 lbs. 8 oz.	Ditto.	
6372	Ditto oil-cake .	20 lbs.	Ditto.	

OILS & FATS. Edible Oils used in India.

Samples despatched to Imperial Institute.

***Register of Collections of Edible Oils sent to the Imperial Institute*—continued.**

	Registration No.	Description of Article and Name of Province.	Quantity.	Action taken.
N.-W. P.		*From Government Farm, Cawnpur.*		
	6440	**Papaver somniferum**, seeds . .	6 lbs.	I. I. Invoice No. 13 of 1895.
	6441	Ditto oil . .	16 lbs. 8 oz,	Ditto.
	6442	Ditto oil-cake .	20 lbs.	Ditto.
Panjab.		*From Deputy Commissioner, Umballa, Panjáb.*		
	7146	**Papaver somniferum**, seeds . .	6 lbs. 12 oz.	I. I. Invoice No. 17 of 1896 and No. 22 of 1896.
	7147	Ditto oil . .	16 lbs. 8 oz.	I. I. Invoice No. 22 of 1896.
	7148	Ditto oil-cake .	17 lbs. 9 oz.	Ditto.
N.-W. P.		*From Director, Land Records and Agriculture, North-Western Provinces and Oudh.*		
	7983	**Papaver somniferum**, oil . .	16 lbs. 14 oz.	Ditto.
		From Deputy Commissioner, Lahore, Panjáb.		
	6789	**Prunus amygdalus**, nuts . .	5 lbs.	I. I. Invoice No. 15 of 1895.
		From Deputy Commissioner, Kohat, Panjáb.		
	7433	**Prunus persica**, seeds . . .	7 lbs. 14 oz.	I. I. Invoice No. 17 of 1896.
	7433A	Ditto oil . . .	½ bottle	I. I. Invoice No. 31 of 1897.
	7433B	Ditto oil-cake . .	1 lb.	I. I. Invoice No. 17 of 1896.

***Register of Collections of Edible Oils sent to the Imperial Institute*—concluded.**

Registration No.	Description of Article and Name of Province.	Quantity.	Action taken.	Samples despatched to Imperial Institute.
	From Deputy Commissioner, Kohat, Panjáb—contd.			Panjab.
7434	**Prunus armeniaca**, nut . . .	16 lbs.	I. I. Invoice No. 17 of 1896.	
7434A	Ditto oil . . .	½ bottle.	I. I. Invoice No. 31 of 1897.	
7434B	Ditto oil-cake . .	2 lbs. 8 oz.	I. I. Invoice No. 17 of 1896.	
	From Deputy Commissioner, Sylhet.			Assam.
6584	**Raphanus sativus**, seeds . .	6 lbs.	I. I. Invoice No. 13 of 1895.	
6585	Ditto oil . . .	12 lbs.	Ditto.	
6586	Ditto oil-cake . .	20 lbs.	Ditto.	
	From Treasury Officer, Malabar, through Board of Revenue, Madras.			Madras.
6774	**Vateria indica**, seeds . . .	2 lbs.	I. I. Invoice No. 15 of 1895.	
6775	Ditto oil . . .	7 lbs.	Ditto.	
6776	Ditto oil-cake . .	30 lbs.	Ditto.	
	From Collector, South Canara, through Board of Revenue, Madras.			
7481	**Vateria indica**, oil . . .	3 lbs. 9 oz.	I. I. Invoice No. 22 of 1896.	
8565	Ditto seeds . . .	2 lbs. 6 oz.	I. I. Invoice No. 40 of 1899.	
8566	Ditto oil . . .	5 lbs. 8 oz.	Ditto.	

On the 23rd November 1898, **Sir F. A. Abel, Bart., K.C.B.**, wrote (letter No. 468-4, Flying Seal No. 160) as follows:—

I have the honour to forward, herewith, a Report by the Director of the Scientific and Technical Department of the Imperial Institute, on the various samples of edible oils which have, from time to time, been received from your Department, for purposes of investigation and valuation.

PROFESSOR DUNSTAN'S REPORT.

You will observe that, in the case of the Safflower Oil at any rate, it is intended to carry out a further, more complete chemical examination of the sample. Steps will also be taken to obtain commercial valuations of, at any rate, some of the oils in question, which can now be better done by the light of the results of their examination here. It is probable, moreover, that the account which will be given of the results of their examination of the oils by Messrs. Crossley and Le Sueur, and published in the *Journal of the Society of Chemical Industry*, will direct the attention of commercial men to this class of oil.

Report by* PROFESSOR W. R. DUNSTAN, F.R.S., *Director of the Scientific Department, Imperial Institute.

Among the subjects awaiting investigation by the Scientific Department at the beginning of the present year was that of Indian Edible Oils, samples of which have been collected in India during the last two years under the supervision of the Reporter on Economic Products to the Government of India and despatched by him to the Imperial Institute. As the subject is an important one, and the entire staff of the Department was, and is now, occupied with other investigations, most of them on Indian subjects, I decided to arrange for these oils to be examined in my Laboratory at St. Thomas's Hospital by two of my assistants specially competent to engage in such work, Dr. A. W. Crossley, M.Sc., Ph.D., and Mr. H. R. Le Sueur, B.Sc. The Government Grant Committee of the Royal Society were good enough to make a small grant from the Government Fund for Scientific Research to defray the expenses connected with these experiments.

The plan of investigation which seemed to me likely to be most serviceable, was to examine in the first instance the chief physical and chemical characters of each oil, so as to furnish a basis for their comparison with well-known and largely used edible oils, and thus to render it possible to obtain a report on the commercial value of the Indian samples. After this preliminary survey of the entire collection it might prove to be worth while to examine more minutely the chemistry of those oils which appeared to present features of novelty. The preliminary examination of the oils has now been completed by Messrs. Crossley and Le Sueur, who will present an account of their results to the Society of Chemical Industry, which will subsequently

PROFESSOR DUNSTAN'S REPORT.

be printed in the Journal of that Society. By this means it is hoped that the attention of oil-brokers and merchants will be directed to the variety of excellent oils, belonging to almost every class, which are obtainable in India, and that the experimental data will enable us to obtain a trustworthy opinion as to their commercial uses and value. I ought to say that when the oils were first received I made several attempts to ascertain their market value but entirely without success, as no scientific data existed as to their composition and quality.

The following is a list of the oils which have been examined :—

*Amoora Rohituka.
Anacardium occidentale.
Arachis hypogæa.
*Argemone mexicana.
Bassia latifolia.
Bassia butyracea.
Brassica? alba.
Brassica campestris.
Brassica juncea.
Brassica Napus.
Brassica? nigra.
Buchanania latifolia.
Carthamus tinctorius.
Carthamus Oxyacantha.
Cocos nucifera.
Eruca sativa.
Guizotia abyssynica.
Garcinia indica.
Juglans regia.
Lepidium sativum.
Linum usitatissimum.
Olea cuspidata.
Papaver somniferum.
Raphanus sativus.
Vateria indica.

Constants Determined.

The liquid oils, with but one or two exceptions, were perfectly clear and were not, therefore, submitted to any process of purification before analysis. When this was not the case, the sample was first freed from foreign matter by filtration. The solid oils were in all cases melted, filtered, and dried before analysis. The methods employed for determining the constants of the oils are those in ordinary use, and usually the details given in the "The Chemical Analysis of Oils, Fats, and Waxes," by Lewkowitsch, have been followed. The following points were determined :—

Specific gravity.
Melting point.
"Hehner" value.
Viscosity.
Rotatory power.
Dyeing properties.

The following table includes the results of the examination of the chemical and physical characters of the oils in the present collection :—

* *Vide* I. 1. inquiry No. 33—Certain Fixed Oils.

OILS & FATS. **Edible Oils used in India.**

Number.	Scientific name.	English name.	Locality.	Remarks.	Appearance, odour, flavour.
7795	*Amoora Rohituka .	Evergreen tree	Bengal .	...	Clear, dark brown .
7051	Anacardium occidentale.	Cashew nut .	Madras .	...	Ditto .
5856	Arachis hypogæa . .	Ground, earth, or pea-nut.	Ditto .	No. 1 . .	Clear, very pale yellow
5857	,, ,, . .	Ditto .	Ditto .	No. 2 . .	Ditto .
5858	,, ,, . .	Ditto .	Ditto .	No. 3 . .	Ditto .
5859	,, ,, . .	Ditto .	Ditto .	...	Ditto .
7781	*Argemone mexicana .	Mexican or prickly poppy.	Bengal .	...	Dark orange yellow .
7783	,, ,, .	Ditto .	Ditto .	...	Greenish brown . .
6860	Bassia latifolia . .	Butter or mahua-tree.	Ditto .	...	S=yellowish white, L=clear, orange yellow.
7050	,, ,, . .	Ditto .	Ditto .	...	S=yellow, L=clear, deep orange.
6862	,, ,, . .	Ditto .	Madras .	...	S=yellow, L=clear, deep orange.
7058	,, ,, . .	Ditto .	Ditto .	...	S=yellowish white, L=clear, orange yellow.
7780	,, ,, . .	Ditto .	Ditto .	...	S=white, greenish tinge, L=clear, greenish yellow.
6861	,, ,, . .	Ditto .	N.-W. Provinces.	...	S=dirty yellow, L=clear, deep orange.
7801	,, ,, . .	Ditto .	C. Provinces	...	Ditto .
6752	,, ,, . .	Ditto .	Calcutta .	...	Ditto .
7785	,, ,, . .	Ditto .	Bombay .	...	S=yellowish white, L=clear, yellow.
7788	,, butyracea . .	Indian Butter-tree.	N.-W. Provinces.	...	S=pale orange, L=pale brown.
6856	Brassica ? alba . .	White mustard.	Bengal .	...	Clear, pale yellow, mustard smell.
6865	,, campestris .	Rape seed .	N.-W. Provinces.	var. red .	Ditto .
6863	,, ,, .	Ditto .	Ditto .	,, glauca .	Ditto .
6864	,, ,, .	Ditto .	Ditto .	,, dichotome	Clear, brownish-yellow.

* *Vide* I. I. inquiry No. 33—Certain Fixed Oils.

Edible Oils used in India. (*W. R. Dunstan.*) **OILS & FATS.**

Specific gravity at 15·5°C.	Acid value. As KOH.	Acid value. As Oleic acid.	Saponification value.	Iodine value.	Reichert Meissel value.	Insoluble fatty acids.	D=drying oil. SD=semi-drying oil. ND=non-drying oil.	Rotation in 20 c. m. tube.	Viscosity. Number of seconds for 50 ccs. to flow at 70°F.	Viscosity. Ratio to water at 70°F.	Melting point.
·9386	17·03	4·28	189·70	134·86	1·64	93·23	D.	...	375·8	14·79	
·9594	...	...	45·10	294·26	1·26	...	N. D.	...	...	...	
·9223	5·76	1·45	190·10	98·47	·00	95·63	N. D.	—7′	350·1	13·78	
·9223	9·60	2·42	185·60	98·42	·00	...	N. D.	+24′	347·0	13·67	
·9256	32·91	8·28	194·80	92·43	·00	...	N. D.	inactive	429·3	16·90	
·9195	27·02	6·80	192·1	100·82	·00	...	N. D.	—7′	306·9	12·10	
·9247	6·00	1·51	190·3	122·53	·00	95·07	D.	...	268·9	10·59	
·9259	83·90	21·13	187·8	119·91	·00	...	D.	...	272·0	10·71	
at 100° C.									at 140°F.	at 140° F.	
·8975	11·79	2·97	194·0	62·11	·44	94·95	...	...	97·1	4·24	24·5°
·8962	19·15	4·80	192·6	64·88	...	...	...	...	93·8	4·10	26·0
·8981	10·33	2·60	191·8	67·85	...	...	...	...	96·9	4·23	25·0
·8970	4·83	1·23	190·9	58·53	...	...	...	...	107·0	4·67	26·5
·8964	8·67	2·16	187·4	58·45	...	94·69	...	...	100·6	4·39	29·0
·8969	21·20	5·33	189·5	63·51	...	...	...	...	93·9	4·10	23·0
·8971	17·05	4·29	188·8	63·01	...	...	...	...	96·7	4·22	24·0
·8943	70·82	17·83	193·2	58·59	·88	...	...	...	90·4	3·95	25·5
·8980	6·83	1·72	190·5	53·43	...	...	...	...	96·9	4·23	24·0
·8970	16·44	4·14	190·8	42·12	·44	94·86	...	...	110·4	4·82	39·0
·9142	5·40	1·36	171·2	96·75	·00	95·86	N. D.	—9′	402·0	15·82	
·9148	2·90	·73	171·6	99·20	·79	96·30	S. D.	—7′	390·6	15·38	
·9142	1·78	·45	171·4	97·71	·67	95·04	S. D.	—10′	402·6	15·85	
·9154	1·57	·39	172·2	104·84	·22	95·57	S. D.	...	371·8	14·64	

OILS & FATS. **Edible Oils used in India.**

Number.	Scientific name.	English name.	Locality.	Remarks.	Appearance, odour, flavour.
7784	Brassica campestris .	Rape seed .	Pánjab .	...	Clear, brownish-yellow
7786	,, ,, .	Ditto .	Bombay .	var. brown .	Slightly cloudy, pale brown.
7790	,, ,, .	Ditto .	Ditto .	,, yellow .	Clear, orange yellow .
7791	,, juncea . .	Indian mustard.	Ditto .	,, mustard	Clear, pale yellow .
6855	,, ,, . .	Ditto .	Bengal .	,, Rai .	Clear, dark orange .
6857	,, ? nigra . .	Black mustard	Ditto .	...	Ditto .
7803	,, ,, . .	Ditto .	C. Provinces	...	Ditto .
6978	Buchanania latifolia .	...	N.-W. Provinces.	...	S=pale orange, L=pale orange.
7854	,, ,, .	...	Ditto .	...	S=brownish yellow, L=pale brown.
7806	Carthamus tinctorius .	Safflower .	C. Provinces	...	Clear, orange yellow .
7792	,, ,, .	Ditto .	Bengal .	Pressed oil .	Black, pitchy smell .
7793	,, ,, .	Ditto .	Ditto .	Distilled .	Clear, orange yellow .
6900	,, ,, .	Ditto .	Panjáb .	...	Ditto .
6898	,, ,, .	Ditto .	Ditto .	Oil from cultivated form.	Clear, light yellow .
6901	,, ,, .	Ditto .	Hyderabad	Cold dry expression.	Ditto .
6902	,, ,, .	Ditto .	Bombay .	Oil from dye plant.	Ditto .
6903	,, ,, .	Ditto .	Ditto .	Oil from oil-seed plant.	Ditto .
7048	,, ,, .	Ditto .	Cawnpur .	var. thornless	Ditto .
7049	,, ,, .	Ditto .	Ditto .	,, thorny .	Clear, orange yellow .
6979	,, ,, .	Ditto .	Madras .	...	Clear, pale yellow .
6794	,, Oxyacantha.	Ditto .	Panjáb .	...	Clear, pale orange .
6867	Cocos nucifera . .	Cocoa palm .	Malabar .	...	S=white, L=straw colour.

Edible Oils used in India. (*W. R. Dunstan.*) OILS & FATS.

Specific gravity at 15·5°C.	Acid value. As KOH.	Acid value. As Oleic acid.	Saponification value.	Iodine value.	Reichert Meissel value.	Insoluble fatty acids.	D=drying oil. SD=semi-drying oil. ND=non-drying oil.	Rotation in 20 c. m. tube.	Viscosity. Number of seconds for 50 ccs. to flow at 70°F.	Viscosity. Ratio to water at 70°F.	Melting point.
·9163	2·57	·65	173·4	96·25	·43	94·56	S. D.	...	393·2	15·48	
·9171	4·00	1·00	172·8	94·10	·00	...	S. D.	...	464·6	18·29	
·9141	1·42	·36	169·4	96·66	·00	...	S. D.	—5′	413·8	16·29	
·9206	3·72	·94	180·1	108·29	·89	...	S. D.	—25′	382·8	15·08	
·9158	7·12	1·79	172·1	101·82	·33	95·49	S. D.	—18′	379·3	14·93	
·9155	7·35	1·85	173·3	98·84	·00	96·05	N. D.	—17′	425·4	16·75	
·9185	5·72	1·44	173·0	110·51	·00	...	N. D.	—30′	355·4	13·99	
at 100°C.									at 140°F.	at 140°F.	
·8941	15·03	3·78	195·4	54·73	·33	95·80	...	...	89·3	3·90	32·0
·8943	40·11	10·09	191·8	59·92	...	94·87	...	...	84·6	3·69	32·0
·9267	10·41	2·62	192·5	140·05	...	95·30	D.	+8′	256·1	10·08	
·9634	...	...	188·0	128·93	...	...	D.	...	...	...	
·9264	3·68	·92	190·3	144·4	...	...	D.	+7′	247·8	9·76	
·9275	8·28	2·08	186·6	138·64	·00	...	D.	...	274·5	10·81	
·9267	·76	·19	189·6	144·05	...	...	D.	+10′	249·1	9·81	
·9277	2·58	·65	187·9	138·60	...	...	D.	+14′	274·7	10·79	
·9262	2·67	·67	187·2	143·4	...	...	D.	+8′	250·3	9·85	
·9269	6·20	1·56	191·3	149·93	...	...	D.	+4′	249·6	9·83	
·9271	5·92	1·49	189·4	141·42	·00	...	D.	+7′	258·8	10·19	
·9251	20·02	5·04	190·5	141·12	·00	...	D.	...	243·0	9·57	
·9280	4·12	1·04	192·4	142·85	...	...	D.	+6′	268·8	10·58	
·9270	3·66	·92	189·4	135·49	...	95·44	S. D.	+7′	294·0	11·57	
at 100° C.									at 140°F.	at 140°F.	
·9030	35·21	8·86	258·2	8·54	6·71	...	...	...	63·9	2·79	23·5

OILS & FATS. Edible Oils used in India.

Number.	Scientific name.	English name.	Locality.	Remarks.	Appearance, odour, flavour.
6852	Cocos nucifera . .	Cocoa palm .	Bengal .	...	S=white, L=clear, pale yellow.
7798	,, ,, . .	Ditto .	Bombay .	...	S=white, L=clear, colourless.
7797	Eruca sativa . .	Allied to mustard.	Ditto .	...	Slightly cloudy, orange yellow, turnip smell.
7794	,, ,, . .	Ditto .	Panjáb .	...	Clear, dark orange .
6866	,, ,, . .	Ditto .	Cawnpur .	...	Light brown, green tint
7782	Guizotia abyssynica .	Niger seed .	Bombay .	...	Clear, pale yellow .
7796	,, ,, .	Ditto .	Madras .	...	Clear, light orange .
7799	,, ,, .	Ditto .	Bengal .	...	Ditto .
7804	,, ,, .	Ditto .	C. Provinces	...	Ditto .
7835	Garcinia indica . .	Kokam Butter	Bombay .	...	S=pale brown, L=clear brown.
7851	Juglans regia . . .	Walnut tree .	Panjáb .	...	Orange yellow, linseed smell.
7853	Lepidium sativum . .	Cress . .	Ditto .	...	Orange yellow . .
7805	Linum usitatissimum .	Linseed, flax .	C. Provinces	...	Light brown . .
6858	Brassica Napus . .	Lutni mustard	Bengal .	...	Ditto . .
7852	Olea cuspidata . .	Olive . .	Panjáb .	...	Greenish brown . .
7789	Papaver somniferum .	Opium or white poppy.	Ditto .	...	Light brown . .
7787	,, ,, .	Ditto .	N.-W. Provinces.	...	Clear, orange yellow .
6859	,, ,, .	Ditto .	Ditto .	...	Ditto .
6854	,, ,, .	Ditto .	Bengal .	...	Ditto .
6868	Raphanus sativus . .	Radish .	Assam .	...	Clear, light brown .
7036	Vateria indica . .	White dammar.	Madras .	...	S=greenish white, L=clear, greenish yellow.
7802	,, ,, . .	Ditto .	Ditto .	...	Ditto .

Edible Oils used in India. (*W. R. Dunstan.*) **OILS & FATS.**

Specific gravity at 15·5°C.	Acid value. As KOH.	Acid value. As Oleic acid.	Saponification value.	Iodine value.	Reichert Meissel value.	Insoluble fatty acids.	D = drying oil. SD = semi-drying oil. ND = non-drying oil.	Rotation in 20 c. m. tube.	Viscosity. Number of seconds for 50 ccs. to flow at 70°F.	Viscosity. Ratio to water at 70°F.	Melting point.
·9040	11·84	2·98	255·6	8·41	6·79	82·35	...	...	64·7	2·83	24·5
·9042	9·95	2·50	255·5	8·25	6·65	...	...	...	64·5	2·82	25·0
·9177	2·10	·53	170·4	99·72	·66	95·49	N. D.	...	371·0	14·61	
·9152	3·70	·93	169·0	97·41	·11	...	N. D.	−11′	405·8	15·98	
·9165	2·51	·63	174·1	99·10	·77	...	N. D.	−18′	369·4	14·54	
·9263	9·75	2·45	191·8	126·60	·33	94·11	D	inactive	292·6	11·52	
·9251	5·21	1·31	191·3	131·70	·11	...	D.	,,	263·1	10·36	
·9248	11·69	2·94	188·9	128·60	·11	...	D.	,,	283·7	11·17	
·9263	7·05	1·77	192·2	133·80	·63	...	D.	+18′	273·9	10·78	
at 100° C.									at 140° F.	at 140°F.	
·8889	14·15	3·56	186·8	34·21	·11	94·59	...	...	101·1	4·41	42
·9259	10·07	2·53	192·5	143·10	·00	95·44	S. D.	+16′	231·8	9·13	
·9221	4·18	1·05	183·1	118·40	·22	95·57	S. D.	...	321·6	12·66	
·9337	4·84	1·22	191·5	165·40	·00	94·81	D.	+6′	211·7	8·33	
·9146	3·77	·95	167·7	97·70	·00	95·55	N. D.	−15′	398·0	15·67	
·9203	5·06	1·27	190·9	93·67	·60	95·14	N. D.	...	312·3	12·29	
·9255	10·78	2·71	196·8	137·10	·00	...	D.	inactive	254·8	10·03	
·9260	6·35	1·60	190·1	133·70	·00	...	D.	,,	259·1	10·21	
·9268	11·02	2·77	190·6	133·90	·00	94·97	D.	,,	258·7	10·19	
·9255	8·68	2·18	189·0	134·00	·00	...	D.	+4′	253·9	10·00	
·9163	14·47	3·64	173·8	92·85	·33	95·94	N. D.	+17′	385·3	15·17	
at 100° C.									at 140° F.	at 140°F.	
·8907	5·18	1·30	189·2	39·63	·44	95·21	...	...	104·0	4·54	37·5
·8900	15·34	3·86	188·7	37·82	·22	95·14	...	...	101·5	4·43	37·0

PROFESSOR DUNSTAN'S REPORT.

The following is a classification of the oils according to their drying properties:—

Drying.

***Amoora Rohituka.**
***Argemone mexicana.**
Carthamus tinctorius.
Guizotia abyssynica.
Linum usitatissimum.
Papaver somniferum.

Non-drying.

Anacardium occidentale.
Arachis hypogæa.
Brassica? alba.
Brassica? nigra.
Eruca sativa.
Brassica Napus.
Olea cuspidata.
Raphanus sativus.

Semi-drying.

Brassica campestris.
Brassica juncea.
Carthamus Oxyacantha.
Juglans regia.
Lepidium sativum.

Solid *or* semi-solid *at ordinary temperatures.*

Bassia latifolia.
Buchanania latifolia.
Cocos nucifera.
Garcinia indica.
Vateria indica.

The chief characters of the oils may thus be summarised:—

***Amoora Rohituka.**—(No. 1.)—The seeds of this evergreen tree yield an oil which is used by the natives for various economic purposes, such as illuminating, and medicinally. The sample examined by us is clear and of a reddish brown colour, without any particular taste and a slight odour resembling that of linseed oil. It is a drying oil and its constants approximate to those of Niger seed.

Anacardium occidentale.—(No. 2.)—Cashew nut. Two distinct oils are produced from this plant, the one, pressed from the kernels, is a light yellow, bland oil, the other, known as Cardole or Cashew apple oil, is prepared from the pericarp or shell of the nut, and is black, acrid and powerfully vesicating. The sample examined apparently belongs to the latter class, it is clear, and of a very dark reddish-brown colour. Though it possesses the abnormal iodine value of 294·6 (mean of three determinations) practical experiment shows it to be a non-drying oil. It has evidently suffered decom-

* *Vide* I. I. inquiry No. 33—Certain Fixed Oils.

PROFESSOR DUNSTAN'S REPORT.

position, and this rendered it impossible to determine some of its constants, *e.g.*, in attempting to carry out the determination of the insoluble fatty acids they appeared as a dark brown gummy mass.

Arachis hypogæa.—(Nos. 3 to 6.)—The four samples are all of a very pale yellow colour, with little taste or smell, and deposit solid matter on standing. It will be noticed that the specific gravity is higher than generally recorded, approaching rather closely to that of poppy-seed oil with which **Arachis** oil is said to be adulterated. The iodine value, however, is normal, *i.e.*, below 100, whereas the iodine value of poppy-seed oil is over 130. It is hardly necessary to again point out that the genuineness of our samples is undoubted.

***Argemone mexicana.**—(Nos. 7 and 8.)—The spiny herbaceous annual from the seeds of which this oil is extracted is very abundant in India, and practically an unlimited amount of the oil is available. Of the two samples one, No. 7, is of a dark, orange colour, and possesses a slight but distinct smell. The other, No. 8, is greenish brown in colour, contains a very large percentage of free fatty acids and is completely soluble in 9 and 10 volumes of absolute alcohol at the ordinary temperature, whereas No. 7 is not soluble even at a temperature of 40° C. We mention this fact, because **Charbonnier** has stated that this oil is soluble in 5-6 volumes of alcohol at 32·2° C., a statement which has been refuted by **Fluckiger.** It is evidently quite possible for both statements to be correct. Both our samples come under the heading of drying oils.

Bassia latifolia.—(Nos. 54 to 62.)—Mahua Butter. Our samples of this oil, which is also known as Illipe butter, possess in the solid state a yellow colour, one sample, No. 58, having a decided green tinge; when liquefied they are clear, and vary in colour from yellow to orange. This oil is not identical with, and should not be mistaken for, Mohwah butter or Mowrah seed oil, which is extracted from the seeds of **Bassia longifolia,** nor with Phulwara butter, which is obtained from **Bassia butyracea,** or Indian butter tree.

Brassica family.—(Nos. 9 to 29.)—No. 9, **Brassica ? alba** or white mustard, is of a clear, pale yellow colour and smells of mustard seed oil. Its constants are almost identical with those of the other members of this family.

* *Vide* I. I. inquiry No. 33—Certain Fixed Oils.

PROFESSOR DUNSTAN'S REPORT.

Brassica campestris.—(Nos. 10 to 15) include specimens of all the varieties produced in India. They are clear oils varying in colour from yellow to pale brown, and possess the characteristic mustard smell.

Brassica juncea—(Nos. 16 and 17) is largely used in India as an article of food and also medicinally. They are clear, yellow oils possessing a distinct odour and taste.

Brassica Napus—(No. 18), Lutni mustard, is clear and light-brown in colour.

Brassica nigra—(Nos. 19 and 20) are clear and dark orange coloured.

The whole **(Brassica)** family belong to the class of semi-drying oils.

Buchanania latifolia.—(Nos. 64 and 65).—This oil is rarely prepared, as the seeds are much prized by the natives of India as a sweetmeat. The constants of the specimens, which in the solid state are orange, and in the liquid state clear orange and pale brown, respectively, agree closely with those of **Bassia latifolia.**

Carthamus tinctorius.—(Nos. 21 to 32.)—Safflower oil is extracted from an herbaceous plant, which until recently was cultivated all over India for the preparation of the well known dye. Two distinct varieties of plants are grown, the spiny or thorny variety and the spineless or thornless variety. The oil is obtained from two kinds of fruit, one the cultivated—a white and glossy form; the other smaller and of a mottled brown.grey and white appearance. Two methods are employed for the preparation of the oil, the ordinary cold dry expression method and the so-called hot extraction process, which latter is in reality a crude process of downward distillation. The first method yields an oil which is largely used for burning, whereas that obtained by the latter process is useless for this purpose, and is employed by the natives for the preservation of leathern vessels, ropes, etc., exposed to the action of the water. The samples (21 to 32) include all the different varieties prepared in India. They are, with the exception of No. 22, clear, and vary in colour from very pale yellow to orange, possess a faint odour and taste, neither of which is particularly characteristic. They rotate the plane of polarisation slightly to the right, and in general resemble the white poppy-seed and walnut oils.

PROFESSOR DUNSTAN'S REPORT.

Safflower is an exceedingly good drying oil and its chemistry is being thoroughly investigated. No. 22 prepared by the hot extraction process is quite black in appearance and has a decided pitchy smell. Its specific gravity is much higher and its iodine value lower than any of the other samples. It is a non-drying oil.

The species **Oxyacantha** (No. 33) differs but slightly from **tinctorius.**

Cocos nucifera.—(Nos. 66 to 68.)—Cocoanut palm. The constants of these Indian specimens agree with those on record for this oil, except the Reichert-Meissel value, which is markedly higher. In the solid state, Nos. 66 and 67 are white with a faint yellow tinge, and in the liquid state, clear and pale yellow in colour, No. 68 is pure white and when liquefied clear and colourless.

Eruca sativa.—(Nos. 34 to 36.)—This oil is obtained from an extensively cultivated herb, closely allied to the mustards. In India it is used for burning purposes and also to some extent as a food. The physical constants resemble those of the oil yielded by **Brassica campestris.** All three samples are clear and vary in colour from yellow to pale-brown; two of them, Nos. 34 and 36, have a well-marked odour and flavour of turnip, whereas No. 35 has an odour of mustard and a rather pleasant taste. **Eruca sativa** is a non-drying oil.

Garcinia indica.—(No. 69.)—This oil was sent to us in egg-shaped masses of a dirty white colour containing a good deal of foreign matter. After purification it was of a pale brown colour when solid, and melted to a clear brown liquid.

Guizotia abyssynica.—(Nos. 37 to 40.)—Niger seed. The samples of this drying oil are clear and vary in colour from pale yellow to orange.

Juglans regia.—(No. 41.)—Walnut tree. The sample is clear and of an orange yellow colour with a slight odour of linseed and a sickly nutty flavour. Its constants agree well with those previously recorded, and are almost identical with those of **Carthamus tinctorius.** Practical experiment shows it to be a strong drying oil.

Lepidium sativum.—(Nos. 42 and 43.)—Garden cress. The samples of this oil are of an orange colour and possess a faint smell. The difference in their iodine values is marked; they belong to the class of semi-drying oils.

PROFESSOR DUNSTAN'S REPORT.

Linum usitatissimum.—(No. 44.)—Linseed. The sample is of a clear, orange colour and possesses an iodine value lower than is usually recorded.

Luffa ægyptiaca.—(No. 45.)—The oil is extracted from the seeds of a genus of climbing plants belonging to the family CUCURBITACEÆ. The sample is dark, reddish brown in colour, possesses a slight smell and is a semi-drying oil.

Nigella sativa.—(No. 46.)—Small fennel, Two kinds of oil are expressed from the seeds of this plant, the one is described as dark, fragrant and volatile, and the other clear, nearly colourless and of the consistency of castor oil. Our sample evidently belongs to the first class, it is of a dark, reddish brown colour, with a strongly marked odour of Eucalyptus, and is a semi-drying oil. On standing it deposits solid matter.

Olea cuspidata.—(No. 47.)—The sample is clear, of a greenish brown colour. Its iodine value is abnormally high.

Papaver somniferum.—(Nos. 48 to 51.)—Opium or white poppy. The oils vary in colour from pale yellow to orange, and possess a small but decided lævo-rotatory power. They are drying oils.

Prunus armeniaca.—(No. 52.)—Apricot kernel. The oil is of a pale, orange colour, it has a marked odour and flavour of bitter almonds, and is a semi-drying oil.

Raphanus sativus.—(No. 53.)—Radish seed. The sample is clear, of a light-brown colour, and has a distinct acrid flavour. It is a non-drying oil.

Vateria indica.—(Nos. 70 and 71.)—Both samples in the solid state are white, with a greenish tinge, and when melted are clear and greenish yellow in colour. The constants resemble those of **Garcinia indica.**

O. 84.

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